Working Paper
Economic Series 11-09
May 2011

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"THE SKEWNESS OF SCIENCE IN 219 SUB-FIELDS AND A NUMBER OF AGGREGATES"

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Abstract

This paper studies evidence from Thomson Scientific about the citation process of 3.7 million articles published in the period 1998-2002 in 219 Web of Science categories, or sub-fields. Reference and citation distributions have very different characteristics across sub-fields. However, when analyzed with the Characteristic Scores and Scales technique, which is replication and scale invariant, the shape of these distributions over three broad categories of articles appears strikingly similar. Reference distributions are mildly skewed, but citation distributions with a five-year citation window are highly skewed: the mean is twenty points above the median, while 9-10% of all articles in the upper tail account for about 44% of all citations. The aggregation of sub-fields into disciplines and fields according to several aggregation schemes preserve this feature of citation distributions. It should be noted that when we look into subsets of articles within the lower and upper tails of citation distributions the universality partially breaks down. On the other hand, for 140 of the 219 sub-fields the existence of a power law cannot be rejected. However, contrary to what is generally believed, at the sub-field level the scaling parameter is above 3.5 most of the time, and power laws are relatively small: on average, they represent 2% of all articles and account for 13.5% of all citations. The results of the aggregation into disciplines and fields reveal that power law algebra is a subtle phenomenon.

This is the second version of the paper in this series that appeared in 2010 with the number 10-38. The authors acknowledge financial support from the Spanish MEC through grants SEJ2007-63098, SEJ2007-67436, ECO2009-11165, and ECO2010-19596. The database of Thomson Scientific (formerly Thomson-ISI; Institute for Scientific Information) has been acquired with funds from Santander Universities Global Division of Banco Santander. This paper is part of the SCIFI-GLOW Collaborative Project supported by the European Commission's Seventh Research Framework Programme, Contract no. SSH7-CT-2008-217436, and was presented in a Poster Session of the STI Conference held in Leiden, 9-11 September, 2010.

INTRODUCTION

It is well known that, among other factors, differences in publication practices across research areas regarding the length of the average article in the periodical literature and the number of articles per person, are responsible for large differences in area sizes measured by the number of articles per area. It is also well known that, due to vastly different citation practices, reference distributions have very different mean rates and other characteristics. In turn, it is equally well known that citation distributions have very different characteristics across scientific fields.

This diversity seems to be compatible with the belief among Scientometrics' practitioners that citation distributions share some fundamental characteristics. As originally suggested in Price (1965) and afterwards analyzed in Seglen's (1992) seminal contribution, it is generally believed that citation distributions are highly skewed. Moreover, it is widely held that citation distributions can be represented by power laws (see Egghe, 2005, for a treatise on the importance of power laws for information production processes of which citation distributions are only one type). More recently, in two important contributions Radicchi *et al.* (2008) and Glänzel (2010) suggest that since citation distributions only differ by a scale factor, after appropriate normalization we can speak of a (highly skewed) universal citation distribution. The problem is that the empirical evidence sustaining these beliefs is, although valuable, not conclusive. This paper contributes to setting the record straight at different aggregation levels for a large sample of 3,7 million scientific articles published in the period 1998-2002, acquired from Thomson Scientific (TS hereafter).

The shortcomings of the present situation are of two types. Firstly, claims of such regularities appearing in the literature are based on an accumulation of case studies. Most of the evidence is not systematic. As far as the skewness of citation distributions is concerned, together with the illustrations in Seglen's paper from a random sample of articles drawn from the 1985-1989 Science Citation Index, and Magyar's (1973) data on the small sub-field of dye laser research, a first set of papers only includes the contributions of Irvine and Martin (1984) and Lehmann *et al.* (2003) on high energy physics, and Burke and Butler (1996) on the entire fields of the natural sciences and the social sciences and the humanities in Australian universities. On the other hand, beyond the graphical illustrations included in Narayan (1971) and Seglen (1992), the only directly estimated results that we have found in the fitting of power laws to citation distributions are for papers on all fields published in 1981 and listed in the Science Citation Index (Redner, 1998, Clauset *et al.*, 2009), papers published in *Physical Review* during long time periods (Redner, 1998, 2005), 18,000 publications in Chemistry in the Netherlands during 1991-2000 with a three-year citation window (Van Raan, 2006), and papers in high energy physics (Lehmann *et al.*, 2003, 2008); Laherrère and Sornette (1998) study the citation record of the most cited physicists, while Clauset *et al.* (2009) include the publication record of mathematicians.

Secondly, the available evidence does not confront what we call the aggregation issue. On one hand, the smaller the set of closely linked journals used to define a given research field, the greater the homogeneity of citation patterns among the articles included must be. This homogeneity guarantees that the relative merit of articles in a given field can be measured by their number of citations. Moreover, when questioned, most scientists would answer that they belong to one, or at most a few, well-defined research areas. Consequently, one should always work at the lowest aggregation level that the data allows for. In this paper, research areas at that level are referred to as *sub-fields*. On the other hand, given the plethora of scientific sub-fields that easily reach between two and three hundred, for many practical problems the interest of investigating larger aggregates is undeniable. Above sub-fields, this paper distinguishes between an intermediate category –referred to as *disciplines*, such as Internal Medicine or Dentistry; Particle and Nuclear Physics or Physics of Solids; and Organic or Inorganic Chemistry– and traditional, broad fields of study such as Clinical Medicine, Physics and Chemistry, referred to simply as *fields*. In this context, the aggregation issue is whether the existence of common characteristics for all –or most– citation distributions, is a phenomenon dependent of the aggregate level of analysis. In other words, we should investigate whether these characteristics are only present at a high aggregation level and disappear at the sub-field level or, on the contrary, whether they are present at the lowest aggregation level and, in this case, whether they are preserved or not at higher aggregate levels.

For this purpose, it would be very convenient to have a hierarchical Map of Science organizing sub-fields, disciplines, and fields in a way agreed upon by the international scientific community. It is true that many journals can be unambiguously assigned to one specific sub-field, one discipline, and one field. However, many other journals typically receive a multiple assignment. As a result, each Map of Science necessarily contains a projection from a specific perspective (see *inter alia* the important contributions by Small, 1999, Boyack *et al.*, 2005, Leydesdorff, 2004, 2006, and Leydersdorff and Rafols, 2009, as well as the references they contain). To appreciate at a glance the complex pattern of inter-relationships among sub-fields –and even among larger aggregates– whenever large samples are considered, it suffices to inspect Figure 1 in Small, 1999, Figure 5 in Boyack *et al.*, 2005, or Figures 3 and 4 in Leydersdorff and Rafols, 2009.

The situation can best be illustrated in our original data set. After excluding Arts and Humanities for its intrinsic peculiarities, about 8.2 million papers published in the period 1998-2007 are classified into the 20 natural sciences and the two social sciences distinguished by TS. Also, there is information about 219 Web of Science (WoS hereafter) categories that one would like to connect to the 22 TS scientific fields. However, two different obstacles stand in the way. Firstly, each article in our dataset is assigned to one or more WoS categories, up to a maximum of six. In particular, only about 58% of the total number of articles is assigned to a single WoS category. The question is: what should be done with the remaining 42% of multi-WoS category articles? Secondly, each article is assigned to a single TS field but, precisely because of the inexistence of a Map of Science generally accepted by all, TS does *not* provide a link between the 219 WoS categories and the 22 TS fields. Thus, the connection between many WoS categories and the TS fields is not at all obvious.

In short, the task of deciding what a sub-field should be at the lowest level of aggregation, as well as the drawing of the lines connecting each sub-field to a single discipline and a single field, constitute formidable practical problems that must be solved prior to the study of citation distributions at different aggregation levels. In this scenario, the limitations of the only three groups of systematic studies available in the literature should be readily apparent. (i) Schubert *et al.* (1987) analyze the papers published in the period 1981-1985 in the journals covered by the Science Citation Index, and the citations received during this same period. These authors work at a low aggregation level, consisting of the 114 sub-fields distinguished at the time in the Journal Citation Reports. They study the shape of citation distributions by applying the Characteristic Scores and Scales (CSS hereafter) technique that permits the partition of any distribution of articles into a number of classes as a function of their members' citation characteristics. However, no statistical test of the presence of common characteristics at this level is provided, and no aggregation into scientific fields or disciplines is attempted. Glänzel (2007a) studies 450,000 citable papers published in 1980, cited in the 1980-2000 period, and classified into 60 disciplines and 12 major fields. However, this study only reports results for the application of CSS to 12 of the 60 disciplines. None of these papers directly estimate a power law. Instead, under the hypothesis that a citation distribution consisting of those articles receiving at least one citation follows a power law, Glänzel (2007a) obtains an equation relating the scaling parameter of this distribution and the parameters of the CSS technique. With direct estimates of the latter, the former are computed.[1] (ii) Radicchi *et al.* (2008) focus on the evaluation of citation performance of single publications in different research areas. They conclude that , "…*in rescaling the distribution of citations for publications in a scientific discipline by their average number, a universal curve is found, independent of the specific discipline*" (p. 17269). They indicate that the universal normalized citation distribution resembles a lognormal distribution, whose single parameter is estimated. However, the empirical evidence they provide only refers to 14 sub-fields or World of Science categories that, nevertheless, span broad areas of science. Based on an observation in an earlier paper by Schubert *et al.* (1989), Glänzel (2010) studies a normalization similar to the one suggested by Radicchi *et al.* (2008). The problem, again, is that evidence is only presented for the 12 disciplines analyzed in Glänzel (2007a). (iii) Using the same dataset as this paper, Albarrán and Ruiz-Castillo (2011) study the shape of reference and citation distributions using the CSS technique, and estimate power laws using state-of-the-art, maximum likelihood techniques. However, the work is only conducted at a high aggregation level, namely, the 22 TS fields.

In this paper, the notion of a sub-field is identified with that of a WoS category. To deal with the problem of multiple assignments of articles to WoS categories, we adopt a multiplicative strategy in which items classified into several sub-fields are wholly counted in all of them. On the other hand, given the difficulties inherent in any aggregation scheme, we consider two alternatives routes inspired in Tijssen and van Leeuwen (2003) and Glänzel and Schubert (2003) to climb up from the sub-field

[1] Under the same restrictive hypothesis, Schubert and Glänzel (2007) and Glänzel (2007b, 2008) deduce the scaling parameter from an equation relating the *h*-index and the parameters of the assumed power law.

to the discipline and the field levels. The paper investigates the following two questions. Firstly, whether there exists a typical shape of reference and citation distributions with the same stylized features for sub-fields, disciplines, and fields.[2] Using the CSS approach the answer is that, indeed, as long as we focus on how articles are distributed over three broad categories reference and citation distributions at all aggregation levels present the same shape. In particular, citation distributions are characterized by a highly skewed shape. However, as long as we focus on smaller segments inside the lower and upper tails of citation distributions higher measures of dispersion indicate a lack of universality across sub-fields. Secondly, we establish that in 140 out of 219 sub-fields the existence of a power law cannot be rejected. However, their main features are rather different from what they are generally believed. We also study the intriguing question of whether power laws at the sub-field level are preserved or not at upper aggregation levels, and whether sub-fields that cannot be represented by a power law give rise to a discipline or a field that exhibits this interesting behavior. Finally, using the results obtained for the two mentioned aggregation schemes, the paper constructs a third procedure that maximizes the possibility that a power law cannot be rejected in the corresponding disciplines and fields.[3]

The rest of the paper is organized into five Sections and an Appendix. Section II presents the data, as well as the assignment of articles to sub-fields, disciplines, and fields according to two Maps of Science described in the Appendix. Section III introduces some basic descriptive statistics that illustrate how different sub-field reference distributions and citation distributions at every aggregation level really are. Section IV analyzes two issues using the CSS approach: (i) the main features of reference and citation distributions at the sub-field level, and (ii) the striking similarities of the shapes of citation distributions at all aggregation levels. Section V is devoted to the estimation of power laws at all aggregation levels. Finally, Section VI discusses the main findings and a number of possible extensions. To facilitate the reading of the paper, the text focuses on the average characteristics of the

[2] The vast majority of articles written in citation analysis exclusively deals with citations received. For an exception, apart from Price's (1965) seminal contribution and Albarrán and Ruiz-Castillo (2011), see Liang and Rousseau (2010) and the references quoted there.

[3] We should make clear that none of the aggregation schemes used in this paper are claimed to provide an accurate representation of the structure of science. They are rather a convenient simplification or a realistic tool for the discussion of the aggregation issue.

different distributions while the information about individual sub-fields, disciplines, and fields is confined to the Appendix.

II. DATA AND TWO AGGREGATION SCHEMES

II.1. The Dataset

TS-indexed journal articles include research articles, reviews, proceedings papers and research notes. Since we wished to address a homogeneous population, in this paper only research articles, or simply articles, are studied. After disregarding review articles, notes, and articles with missing information about WoS category, scientific field, or number of authors, we are left with 8,470,666 articles published in the period 1998-2007, or 95% of the number of items in the original database. A relatively large sample was needed to ensure a minimum size of all areas of study at all aggregation levels. We choose the 3,767,378 articles published between 1998-2002, a sample whose distribution by TS fields was shown in Albarrán and Ruiz-Castillo (2009) to be representative of the 1998-2007 dataset.

The 1998-2007 dataset consists of papers published in a certain year and the citations they receive from that year until 2007, that is, articles published in 1998 and their citations during the 10-year period 1998-2007, articles published in 1999 and its citations in the 9-year period 1999-2007, and so on until articles published in 2007 and their citations during that same year. The time pattern of citations varies greatly among the different scientific areas (see *inter alia* Persson *et al.*, 2004, and Althouse *et al.*, 2008). Therefore, ideally the citation window in each sub-field should be estimated along with other features of the stationary distribution in a dynamic model. This estimation problem is beyond the scope of this paper. Hence, a fixed, common window is chosen for all articles. The standard length in the literature is three years, possibly because it is a long enough period for the citation process to be settled in the fastest areas that include most of natural sciences. However, in this paper a five-year citation window is taken to make sure that the slowest sub-fields are relatively well covered. Note that this simplification implies that certain idiosyncratic features that differentiate some sub-fields from one another will be preserved in our data: five years is a long enough period for the completion of a sizable part of the citation process for some areas, but rather short for others.

However, Glänzel (2007a) has established that, except for a short initial period of four years –below our five-year choice–, the particular length of a citation window is not important for the class sizes determined in the CCS approach applied below. Given the choice of a relatively large citation window and sample size, we conjecture that we are also on the safe side for the estimation of a power law.

II.2. The Classification of Articles into Sub-fields

Table 1 informs about the multi-WoS category structure of the 22 TS fields. The 20 fields in the natural sciences are organized in three large disciplines: Life Sciences, Physical Sciences, and Other Natural Sciences. The last two represent, approximately, 28% and 26% of the total, while the Life Sciences represent about 40%. The remaining 6% correspond to the two Social Sciences.

Table 1 around here

As indicated in the Introduction, only about 58% of all articles are assigned to a single WoS category. These represent as much as 94% of the Multidisciplinary field, but only about 37-43% for Environmental and Ecology, Engineering, and Molecular Biology and Genetics, or 45-46% for Neurosciences and Behavioral Sciences, and Materials Science. The first problem, of course, is how multi-WoS categories articles should be classified into sub-fields. A crucial requirement is that all articles within a sub-field should count the same. Otherwise, if an article assigned to several WoS categories were fractionally assigned to them, then its place in the various citation distributions would be dramatically affected. In particular, fractionally assigned articles would have a much smaller chance of occupying the upper tail of citation distributions than articles assigned to a single WoS category. Therefore, we opt for a *multiplicative* strategy, where each article is classified into as many sub-fields as WoS categories in the original dataset. An article assigned to three WoS categories, for instance, is classified into the three corresponding sub-fields; this means that this article would be counted three times. In this way, the space of articles is expanded as much as necessary beyond the initial size. As a matter of fact, the total number of articles in what we call the *extended count* for the 219 TS sub-fields is 5,509,510, or 57% larger than the original dataset. This artificially large number is not that worrisome in the sense that, since the multiplicative strategy does not create any interdependencies among the sub-fields involved, it is still possible to separately investigate every sub-field in isolation, independently of what takes place in any other sub-field.

II.3. The Classification of Articles into Disciplines and Fields

Assume for a moment that we are given a reasonable classification of sub-fields into disciplines and fields, that is, assume that we have a Map of Science to work with. The next question is how to classify articles into disciplines and fields. Consider first the assignment of articles to disciplines. Articles originally assigned to a single sub-field are directly assigned to the discipline indicated by the Map of Science. For articles assigned to multiple sub-fields we adopt again a multiplicative strategy. For example, consider the case of an article assigned to two subfields. If both belong to the same discipline, then the assignment of the article to a discipline poses no problem. Otherwise, that is, if the two sub-fields belong to two different disciplines, then the article is assigned to both of them. In the case of other multiple sub-field assignments, we would proceed likewise. In this way, the space of articles is expanded as much as necessary beyond the initial size. However, because whenever two or more sub-fields belong to the same discipline no multiplication of the article is necessary, the total number of articles in the disciplines case will be closer to the initial one than in the sub-fields case. A similar process for the assignment of articles to fields should lead to a still lower number of expanded articles.

The question that remains to be answered is how to construct a Map of Science in the presence of the fundamental difficulties mentioned in the Introduction. The strategy followed is to use two alternatives. The first one is based on the TS framework. As we have seen, there is information about the sub-fields an article belongs to and, as indicated in the Introduction, on the single field each article has been assigned to by TS. The problem is that the dataset does not provide the link between sub-fields and fields.[4] Lacking this information, we follow a scheme inspired in Tijssen and van Leeuwen (2003) to establish such a link –TvL hereafter. Given how polemic any Map of Science is, we find it useful to construct a second alternative, this time inspired in a rather different scheme due

[4] TS begins by assigning each journal, and hence all articles published in it, to one or more WoS categories. But in every case, TS has a criterion to classify each article in a field regardless of the complexity of the multi-WoS category structure such an article may have. Apparently, TS uses citation information to and from this journal to classify its articles into only one of the 22 TS fields.

to Glänzel and Schubert (2003) –GS hereafter. In the first case, we end up with 38 disciplines and 12 fields, while in the second case there are 61 disciplines and 12 fields (see the details in the Appendix).[5]

Table 2 provides the number of articles in the extended count corresponding to the two aggregation schemes. In our version of the TvL scheme, disciplines and fields lead to extended counts about 37% and 24% larger than the original dataset. On the other hand, the aggregation of the 219 sub-fields into the 22 TS fields leads to an extended count 28% larger than the original dataset. Finally, as explained in the Appendix, it should be noted that our version of the GS scheme refers exclusively to the natural sciences, excluding the vast majority of the social sciences, the Multidisciplinary field, and a few sub-fields related to the so-called Health and other marginal sciences within Clinical Medicine. Accordingly, the extended counts in the GS scheme should be compared with the original number of articles in the natural sciences. As can be seen in Table 2, the extended count for disciplines and fields in the GS case are about 44% and 20% larger than this number. These percentages are of a similar order of magnitude as in the TvL case.

Table 2

III. DESCRIPTIVE STATISTICS

Before we proceed to search for similarities across citation distributions, it is important to document the differences they present at each aggregation level. In particular, this Section informs about three issues: 1) distribution size at every aggregation level, 2) characteristics of reference and citation distributions at the sub-field level, and 3) characteristics of citation distributions at the remaining aggregation levels.

III.1. Distribution Sizes

Publication practices are very different across sub-fields, disciplines, and fields. In some cases authors publishing one article per year would be among the most productive, while in other instances authors –either alone or as members of a research team– are expected to publish several papers per year. Since WoS categories, disciplines, and fields are not designed at all to equalize the number of

[5] See Zitt *et al.* (2005) for an alternative scheme that solves the multi assignment problem by assigning journals to a single sub-field using a random algorithm, and classifies sub-fields into disciplines and fields according to a version of the OST (*Observatoire des Sciences et des Techniques*) criteria that eliminates all overlaps.

Con formato: Inglés (Estados Unidos) articles published in a given period of time, distribution sizes are expected to differ within all aggregation levels. The individual information about sizes is in Table A1 in the Appendix. For the sub-fields and the two discipline types, the following statistics are presented in Table 3: (i) mean size, (ii) a measure of absolute dispersion, namely, the standard deviation, and (iii) a convenient measure of relative dispersion for skewed distributions, the normalized inter-quantile range (NIQR hereafter), defined as the Interquartile Range divided by the median.

Table 3 around here

As expected, judging by the large dispersion measures sub-field sizes are very different indeed. In the sample of articles published in the 1998-2002 period, the range of variation goes from a minimum of 423 articles (Biology, Miscellaneous), or 893 (Ethnic Studies), and seven sub-fields with fewer than 3,000 articles, to seven sub-fields with more than 100,000 articles and a maximum of 213,448 articles in Biochemistry and Molecular Biology. As observed in Table 3, discipline sizes are also very different. In the TvL case the range of variation goes from two disciplines (out of 38) with fewer than 15,000 articles, to five with more than 300,000 articles, while in the GS case there are four disciplines (out of 61) with less than 20,000 articles and four above 200,000. In the TvL and GS schemes size inequality across fields is not that large (see column 3 in Table A1 and A3 for individual values), while in the TS case the vast majority of the fields are very small: 17 out of 22 fields represent less than 5% of the total (see Table A.2).

III.2. References Made vs. Citations Received At the Sub-field Level

It is useful to review the characteristics of the distributions of references made and citations received, a topic underscored in Price's (1965) pioneer contribution with the very limited but newly available data at his disposal during the early 1960s. It should be noted that our dataset does not indicate how references made by articles published in year t actually become citations received by other articles in years t, $t + 1$, up to $t + 4$ during a five year citation window. Our information is about the references made by articles published in each of the years from 1998 to 2002, and the citations they receive afterwards during the period 1998-2002, 1999-2003, up to 2002-2006, respectively. Nevertheless, we believe that the study of both types of distributions is worthwhile. Since Albarrán and Ruiz-Castillo (2009) studied this issue for the 22 TS fields with the same dataset used here, in this paper we confront the issue in some detail only at the sub-field level. Information about the following five characteristics in each of the 219 TS sub-fields has been collected in the Appendix. Table B presents the individual data on three characteristics: (i) the mean reference and citation rate (MRR and MCR, respectively), (ii) the *h*-index, originally suggested by Hirsch (2005) to assess the scientific performance of individual researchers, and (iii) a measure of relative dispersion. Since the median at the sub-field level is often equal to zero the NIQR cannot be estimated. Instead, the coefficient of variation (CV hereafter) is the statistic that appears in Table B. On the other hand, (iv) the percentage of articles without citations at the sub-field level is in column 1 in Table D1 in the Appendix (The corresponding information for reference distributions is available on request). Finally, recall that references are made to many different items: articles in TS-indexed journals, as well as articles in conference volumes, books, and other documents, none of them covered by TS. Moreover, some references are to articles published in TS journals before 1998 and, hence, outside our dataset. Therefore, an important variable also included in Table B is (v) the ratio of references made over citations received (R/C hereafter). As before, for each of these characteristics three statistics are computed in Table 4 over the 219 sub-fields: the mean, the standard deviation, and the NIQR.

Table 4 around here

The following three comments are in order.

1. On average, reference distributions have a small percentage of articles without references, a rather large MRR and *h*-index, and a relatively low CV. However, except for the latter, the very large absolute and relative dispersion of the different characteristics indicate that they cannot be estimated precisely. In other words, as expected, differences in citation practices give rise to reference distributions that are very different across sub-fields.

2. On average, the R/C ratio is very large indeed. This should be an important factor explaining the dramatic changes experienced by the percentage of uncited articles and the MCR when we turn from the reference to the citation distributions: the first variable increases and the second decreases by a factor of five (see Althouse *et al.*, 2008, for the importance of the R/C ratio in explaining differences in impact factors across fields).

3. In turn, the large dispersion exhibited by the R/C ratio must be partly responsible for an increase in the skewness of citation distributions manifested in both the increase in the CV, and the large dispersion affecting all characteristics. In this respect, note that the decrease of the *h*-index when we turn to citation distributions is offset by a dramatic increase in its absolute and relative dispersion.

III. 3. Some Characteristics of Citation Distributions at Different Aggregation Levels

Table C in the Appendix includes the individual information for disciplines and fields about the MCR, the *h*-index, and the CV; the corresponding information about the percentage of articles without citations is in column 1 in Tables D1 to D3. The average statistics about these four characteristics for disciplines and fields are presented in Table 5.

Table 5 around here

The main point that should be emphasized is the high values of absolute and relative dispersion measures associated with the four characteristics at every aggregation level. As far as these characteristics are concerned, this clearly indicates that citation distributions *within* all aggregation levels are very different indeed. An entirely different matter is the comparison of characteristics' mean values *across* aggregation levels. To begin with, since the *h*-index is sensitive to the size of the distributions, its mean value increases systematically from the lowest to the highest aggregation level. On the contrary, it is very important to point out that, on average, the percentage of uncited articles, the MCR, and the CV are very similar across disciplines and fields. As a matter of fact, the mean values for these characteristics are also similar to those observed for sub-fields in Table 4. This indicates that the two aggregation schemes described in the Appendix have not dramatically altered the mean values of these three characteristics.

IV. THE CSS APPROACH AT DIFFERENT AGGREGATION LEVELS

In the previous Section it was observed that, as a consequence of vastly different publication and citation practices, reference and citation distributions for sub-fields, as well as citation distributions for disciplines and fields are very different indeed in two crucial dimensions (among others): distribution size, and MCR. However, on average, the percentage of articles without citations, the MCR, and the CV are rather similar across aggregation levels. This Section shows that as soon as size and scale invariant measurement instruments are used and, consequently, as soon as we focus on the shape of reference and citation distributions, their similarity both within and across aggregation levels is very much strengthened. We begin by studying the main features of reference and citation distributions according to the CSS approach at the sub-field level, and we end up by establishing the similarity of citation distributions at all aggregation levels.

IV.1. The Shape of Reference and Citation Distributions At the Sub-field Level

As indicated, we begin by applying the CSS methodology to the ordered distribution of references made by the articles published between 1998-2002, $\boldsymbol{r} = (r_1,\ldots, r_n)$ with $r_1 \leq r_2 \leq \ldots \leq r_n$, where r_i is the number of references made by the i-th article, $i = 1,\ldots, n$. The following *characteristic scores* are determined:

$s_0 = 0$

s_1 = mean references per article

s_2 = mean references of articles with references above s_1

s_3 = mean references of articles with references above s_2

These scores are used to partition the set of articles into five categories:

Category 1 $r = s_0$	= articles that make no references;
Category 2 $r \in (s_0, s_1]$	= articles that make *few* references, namely, references lower than average;
Category 3 $r \in [s_1, s_2)$	= articles that make a *fair* number of references, namely, at least average references but below s_2;
Category 4 $r \in [s_2, s_3)$	= articles that make a *remarkable* number of references, namely, no lower than s_2 but below s_3;
Category 5 $r \geq s_3$	= articles that make an *outstanding* number of references, namely, no lower than s_3.

As already indicated, the classification of any distribution into these five categories satisfies two important properties. Firstly, the classification is invariant when the initial distribution is replicated any discrete number of times. Secondly, the classification is invariant when the references each article makes are multiplied by any positive scalar. The first property implies that the classification method only responds to references per article. Consequently, it allows for a comparison of distributions of different sizes.[6] The second property implies that the classification method is independent of the units in which references are measured. Consequently, it allows for a comparison of two distributions with different means.

The classification of the 219 sub-field citation distributions into the five categories is in columns 1 to 5 in Table D1 in the Appendix. To save space, the corresponding information for reference distributions at the sub-field level is only available on request. However, the average and the standard deviation over the 219 sub-fields of the percentage represented by articles in the two lowest and the two highest categories, as well as the percentage of references or citations accounted for by the key categories are in Panel A of Table 6.

Table 6 around here

As far as sub-field reference distributions are concerned, three comments are in order. Firstly, if references were to follow a uniform or a normal distribution, the percentage of articles in categories 1 and 2 together should be 50%, and 12.5% in each of categories 3 and 4, or 25% in both together. Actually, on average the percentages we encounter are not that different from these numbers: 57.4% and 16%, respectively. Secondly, on average the percentage of articles with zero references in category 1 is very small but exhibits a large dispersion. However, as can be observed in the first row of Table 6 the union of categories 1 and 2 has a small standard deviation. Generally, the small standard deviations shown in Table 6 indicate that, once categories 1 and 2 are treated jointly, most differences across sub-fields –present in Section III.2 before applying the scale and size normalization implicit in the CSS technique– tend to disappear. Thirdly, the percentage of references accounted for by category 1 is only 31.3%, while the percentage accounted for by the 16% of articles with a remarkable or outstanding number of references is 35%.

We may conclude that sub-field reference distributions are moderately skewed and, in the partition into three classes consisting of categories 1 + 2, 3, and 4 +5, their shapes are rather similar.

[6] Suppose that there are two distributions *x* and *y* with size *n* and *m*, respectively. Distributions *x* and *y* can be replicated *m* and *n* times, respectively, so that each will be of size *n* times *m* after the operation is performed. However, the replication will leave the classification into five categories of either *x* or *y* unchanged. Thus, the two distributions could be compared using their corresponding *n* x *m* replicas.

Note, however, that the coefficient of variation, namely, the ratio of the standard deviation to the mean, tends to grow as we move from the categories 1 + 2 towards the distributions' upper tail.

As far as sub-field citation distributions are concerned, the key points can be summarized as follows. Firstly, taken separately, categories 1 and 2 represent on average 24.7% and 43.9% of all articles, with large standard deviations equal to 13.9 and 12.5, respectively. Perhaps this is partly due to the fact that we have taken a common 5-year citation window for all sub-fields in spite of the large differences in the time that it takes for citation processes to reach a given degree of completion. Be it as it may, the size of both categories has a strong negative correlation. Consequently, the union of the two categories in Table 6 has a very small standard deviation. Secondly, something similar takes place for categories 4 and 5. Taken separately, they represent 6.8% and 3.2% of all articles with standard deviation equal to 1.1 and 0.7 and, therefore, coefficient of variation 0.162 and 0.219, respectively. However, as observed in Table 6, these measures of dispersion for the union of categories 4 and 5 are 1.7 and 0.17. Thus, to emphasize the common aspects across sub-fields we adopt the partition into three classes: the union of categories 1 and 2, category 3, and the union of categories 4 and 5. The relatively small standard deviations for this partition eloquently inform about how similar the shape of the 219 sub-field citation distributions really are. Nevertheless, we should keep in mind that, as before, the coefficient of variation increases as we move towards the lower and the upper tail of the distributions. Thirdly, in any case, as expected citation distributions are highly skewed: approximately 69% of all articles receive citations below the MCR and account for, at most, 26% of all citations, while 9-10% of all articles in categories 4 and 5 taken together account for approximately 45% of all citations with a small standard deviation of 4.6.

IV.2. Citation Distribution Similarities at All Aggregation Levels

Panels B to D in Table 6 document the fundamental fact that the shape of citation distributions at every aggregate level is essentially the same. By way of example, this is illustrated in Figures 1 and 2 for the 61 and 38 GS and TvL disciplines, respectively. It is important to emphasize that those are exactly the main features found in Albarrán and Ruiz-Castillo (2009) when analyzing reference and citation distributions using the original dataset in which each article is assigned by TS to only one of

22 broad fields. Moreover, small standard deviations in all cases ensure that differences across individual disciplines or fields are as small as across individual sub-fields.

In brief: when citation distributions are partitioned into three classes –including uncited and poorly cited articles below the MCR, fairly cited articles, and remarkably and outstandingly cited articles– they exhibit a strikingly similar shape. This is the shape of a highly skewed distribution where a 9-10% of highly cited articles account for about 45% of all citations. However, the fact that the coefficient of variation tends to increase as we move towards the lower and the upper distribution tails should remind us about the lack of universality of citation distributions in those particular segments.

Figures 1 and 2

Another way of capturing the striking similarity across citation distributions is originally due to Glänzel (2010). He first observes that differences in citation practices give rise to large differences in characteristic scores. However, when appropriately normalized, a number of disciplines in the GS scheme present surprisingly small deviations from the median 3.15 of the normalized characteristic score s_3, denoted s_3* hereafter. The normalization simply involves the transformation of any citation distribution with N papers, $\mathbf{x} = (x_1, \ldots, x_N)$ by the formula

$$u_i^* = x_i/(s_2 - s_1),$$

where s_1 and s_2 are the first two characteristic scores defined in the previous Sub-section. Therefore,

$$s_3^* = s_3/(s_2 - s_1). \tag{1}$$

Column 8 in Table D in the Appendix presents the individual data for s_3* at every aggregation level, while Table 7 contains mean values and standard deviations for s_3 and s_3* at all levels.[7]

Table 7 around here

It is observed that the one standard deviation interval around the mean of s_3 goes from 7.5 to 44.1 for sub-fields, and from 20.2 to 43.6 for GS fields, for example. However, this same interval for

[7] Column 7 in table D informs about the individual values for s_2. Given expression (1) and the fact that the MCR, s_1, appears in column 5 in Table B for sub-fields, and in column 1 in Table C for the remaining aggregation levels, the information about s_2 makes possible the computation of all characteristic scores for every citation distribution studied in this paper.

s_3* is, approximately, (2.8, 3.2) for all aggregation levels. Thus, the normalized s_3* value in our dataset can be taken to be approximately equal to 3 citations, an order of magnitude very close to the figures quoted in Glänzel (2010) for very different samples and citation windows. This means that this normalization strategy seems to work well, which reinforces the idea of the existence of an underlying, universal normalized citation distribution. Nevertheless, note that the percentage of articles in the five CSS categories in the normalized distributions is exactly the same as in the un-normalized, original distributions. Although standard deviations are relatively small (see Table 6), the fact that the coefficient of variation tends to increase as we move towards the upper tail speaks about the variability, or lack of universality in that important segment of citation distributions.

Radicchi *et al.* (2008) also contains some evidence about the universality of citation distributions. These authors normalize the citations received by each article by the mean citation rate of all articles published in the corresponding sub-field. To establish the universality of the resulting distributions, they rank all articles in increasing order of the number of normalized citations received, and compute the percentage of publications in each sub-field that appear in the top z% of the global rank. If the ranking is fair, or unbiased, the percentage of each sub-field should be near z% with small fluctuations. They take the values z% equal to 5%, 10%, 20%, and 40% in the normalized distribution where the articles receiving no citations are eliminated, a decision we find unjustified. Since the percentage of these articles is approximately 25%, we also take the value z% = 75% in the entire distribution. Similarly, since the percentage of articles above s_3, s_2, and s_1 are approximately 3%, 10% and 30%, we also compute the results for these three values. Finally, in order to reach a truly small percentage of highly cited articles, we also include the value z% = 1%. Let N_c and N_i be, respectively, the number of categories and the number of articles in the *i*-th category. Assuming that articles of the various sub-fields are scattered uniformly along the rank axis, for any value z% one would expect the average relative frequency of the number of articles in any sub-field to be z% with a standard deviation

$$\sigma_z = \{[z(100 - z)\Sigma_i\ (1/N_i)]/N_c\}^{1/2},$$

which is equation (2) in Radicchi *et al.* (2008). For each category, column 2 in Table 8 presents the σ_z values, while column 3 is the theoretical coefficient of variation, namely, σ_z/z. Columns 4 to 6 contain the values for z%, σ_z, and σ_z/z obtained empirically in the normalized overall distribution while, for comparison sake, columns 7 to 9 present the same information for the overall ranked original distribution before normalization.

Table 8 around here

Although σ_z varies non-linearly with z, the theoretical coefficient of variation in column 3 raises from 0.01 to 0.11 when we proceed from z = 75% towards z = 1%. As expected, large differences across sub-fields in the un-normalized case translates into seriously biased estimates of z, as well as large estimated values of σ_z and σ_z/z (see columns 7 to 9). In the normalized case, the following two points should be emphasized. Firstly, judging by the large σ_z, estimates for z = 75% and 40% are not that good. This is exactly what we found in the CSS approach: categories 1 and 2 were rather different across sub-fields. However, the union of categories 1 and 2 had a small standard deviation. In the present analysis, the coefficient of variation for z = 30% in column 6 is relatively low. Secondly, the same can be said for the value z = 10%, equivalent to the union of categories 4 and 5 in the CSS approach. However, as we proceed towards the end of the upper tail when z = 5%, 3%, and 1% the coefficient of variation considerably increases.

In brief, when we apply the scale and replication invariance CSS approach to sub-fields distributions partitioned into three segments comprising poorly cited articles with citations below the MCR, fairly cited articles, and remarkably and outstandingly cited articles –or in other words, when we choose the z intervals (100%, 30%), (30%, 10%), and (10%, 0%) in the overall ranked normalized distribution– we can confidently speak of extremely similar shapes across sub-field distributions. Shapes that are preserved at higher aggregate levels. However, when we shift the attention to the lower and the upper tails the appearance of relatively large coefficients of variation reveal the lack of universality of citation distributions' shapes across sub-fields.

This conclusion contrasts with the more optimistic and universalistic view offered by Radicchi *et al.* (2008), starting with their contribution's title. However, the richness of our analysis in a space of

219 sub-fields also contrasts with a methodology that omits zeros, includes a limited set of z values and, above all, covers only 14 sub-fields.

V. RESULTS ON THE ESTIMATION OF POWER LAWS

V.1. Estimation Strategy

This Section studies whether citation distributions at different aggregation levels can be represented by power laws and, when this is the case, which are their main characteristics. Let x be the number of citations received by an article in a given field. This quantity is said to obey a power law if it is drawn from a probability density function $p(x)$ such that

$$p(x)\mathrm{d}x = \Pr\left(x \leq X \leq x + \mathrm{d}x\right) = Cx^{-\alpha}$$

where X is the observed value, C is a normalization constant, and α is known as the exponent or scaling parameter. This density diverges as $x \to 0$, so that there must be some lower bound to the power law behavior, denoted by $\rho > 0$. Then, provided $\alpha > 1$, it is easy to recover the normalization constant that guarantees that the conditional distribution (given that $x \geq \rho$) integrates up to one. Assuming that our data are drawn from a distribution that follows a power law exactly for $x \geq \rho$, and assuming for the moment that ρ is given, the maximum likelihood estimator (MLE hereafter) of the scaling parameter can be derived. If the number of citations x can be regarded as a continuous variable, then the MLE can be obtained according to a closed form analytical formula. In the discrete case, however, the MLE can only be obtained as the numerical solution to the corresponding first order condition equation.[8] We follow the estimation method provided by Clauset *et al.* (2009) that automatically detects whether x is composed of real or integer values and applies the appropriate method. These authors test the ability of the MLEs to extract the known scaling parameters of synthetic power law data, finding that the MLEs give the best results when compared with several competing methods based on linear regression. Nevertheless, for very small data sets the MLEs can

[8] See Appendix B in Clauset *et al.* (2009) for further details on the particular formulas and procedures used in each case.

be significantly biased. Clauset *et al.* (2009) suggest that $T \geq 50$ is a reasonable rule of thumb for extracting reliable parameter estimates, where T is the number o articles for which $x \geq \rho$.

The large percentage of articles with no citations at all, as well as the low value of the mean in most sub-fields (see Table 4), indicate that it is highly unlikely that a single power law would represent the entire citation distribution in any given case. In these circumstances, it is essential to have a reliable method for estimating the parameter ρ, that is, the power law's starting point. In this paper, as in Clauset *et al.* (2009), we choose the value of ρ that makes the probability distributions of the measured data and the best-fit power law as similar as possible above ρ. To quantify the distance to be minimized between the two probability distributions the Kolmogorov-Smirnov, or KS statistic is used. Again, Clauset *et al.* (2009) generate synthetic data and examine their method's ability to recover the known values of ρ. They obtain good results provided the power law is followed by at least 1,000 observations.

The method described allows us to fit a power law distribution to a given data set and provides good estimates of the parameters involved.[9] An entirely different question is deciding whether the power law distribution is even a reasonable hypothesis to begin with, that is, whether the data we observe could possibly have been drawn from a power law distribution. The standard way to answer this question is to compute a *p*-value, defined as the probability that a data set of the same size that is truly drawn from the hypothesized distribution would have a goodness of fit as bad as or worse than the one observed. Thus, the *p*-value summarizes the sample evidence that the data were drawn from the hypothesized distribution, based on the observed goodness of fit. Therefore, if the *p*-value is very small, it is then unlikely that the data are drawn from a power law.

To implement this procedure, we again follow Clauset *et al.* (2009). Firstly, take the value of the KS statistic minimized in the estimation procedure as a measure of its goodness of fit. Secondly, generate a large number of synthetic data sets (in our case, one thousand) that follow a perfect power law above the estimated ρ with scaling parameter equal to the estimated α, but which have the same

[9] As a matter of fact, to estimate the parameters α and ρ we use the program that Clauset *et al.* (2009) have made available in http://www.santafe.edu/~aaronc/powerlaws/.

non-power law behavior as the observed data below ρ. Thirdly, estimate ρ and α in each synthetic sample according to the estimation method already described, and calculate the KS statistic for each fit. Fourthly, calculate the *p*-value as the fraction of the KS statistics for the synthetic data sets whose value exceeds the KS statistic for the real data. If the *p*-value is sufficiently small, say below 0.1, then the power law distribution can be ruled out.

V.2. Results at the Sub-field Level

The full set of individual results is presented in Table E.1 in the Appendix. For the case in which the existence of a power law cannot be rejected, Table 9 includes some summary results, while figure 3 graphically illustrates the distribution followed for some key characteristics. The following two comments are worth noting at this point.

Table 9 and Figure 3 around here

(1) In 140 of 219 sub-fields, which include about 62% of all articles in the sample, the existence of a power law cannot be rejected.[10] This is comparable with the evidence reported in Clauset *et al.* (2009) where for seven of the 24 data sets the *p*-value is sufficiently small that the power law model can be firmly ruled out.[11] When power laws exist, their main characteristics are as follows.

• Only for four sub-fields is the estimated scaling parameter below 3. For 80 sub-fields α has a value between 3 and 4, while for the remaining 56 α is greater than 4 (see Panel B in Table 9 and Figure 3.a). The median value is 3.85.

• Power laws have a relatively large ρ so that they only represent a small proportion of the upper tail of citation distributions but account for a considerable percentage of all citations in their sub-fields. Due in part to the prevalence of articles with none or few citations, on average power laws only represent 2% of all articles. However, the range of variation is large: in 43.5% of all cases they represent less than 2%, in 36.5% between 2% and 5%, and only in 20% of all cases do power laws

[10] It should be noted that even if the null hypothesis of the existence of a power law distribution were true for each of the 219 sub-fields, one should expect a rejection of the null in 21 or 22 sub-fields when carrying out multiple statistically independent tests where rejection takes place for *p*-values lower than 0.10.

[11] This is the case of HTTP connections, earthquakes, web links, fires, wealth, web hits, and the metabolic network.

represent more than 5% of all articles.[12] Although the range of variation is also very great, on average power laws account for about 13% of all citations in their respective sub-fields (see Panel B in Table 9 and Figure 3.c and 3.d). The median values for the percentage of articles and citations are 2.3% and 18.1%, respectively.

As already indicated in Albarrán and Ruiz-Castillo (2011), the range of values found for the scaling parameter is at variance with the evidence in other areas, as well as with the scant evidence in bibliometrics where α is reported to be of a considerably smaller order of magnitude.[13] The implication is that the citation inequality among the articles in the upper tail of citation distributions is smaller than what is usually believed (for the inverse relationship between the size of α and the degree of citation inequality within a power law when ρ is equal to one, see Chapter VI in Egghe, 2005). In particular, the results in this paper clash with the work reported in Glänzel (2007a, 2007b). Glänzel (2007a) concludes that the most relevant range for α is [1.5, 3.5], while Glänzel (2007b) states that for small citation windows of about three years a value of two for this parameter has been found appropriate. Part of the reason might be that, as indicated in footnote 2, in the indirect procedures used in these papers to deduce a value for α it is assumed that $\rho = 1$, that is, excluding articles that receive no citations, the entire citation distribution is assumed to follow a power law. Contrary to this assumption, we let this parameter to be freely estimated and find that the range of estimated values goes from 3 to 172 in sub-fields 16 and 136, respectively (see Table E.1 in the Appendix, and Figure 3.b). The median value is 22.

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[12] There are seven phenomena in Clauset *et al.* (2009) where the sample size is larger than 10,000 observations and a power law cannot be rejected. Ordered by sample size, these are solar flair intensity, count of word use, population of cities, Internet degree, papers authored, citations to papers from all sciences, and telephone calls received. In the last three, the size of the power law is less than 1% of the sample size; in two cases this percentage is between 1% and 3%, and in the remaining three cases this percentage is between 8% and 16%. In the Redner (1998) case, the power law represents about 1.53% of the 783,339 papers published in all fields in 1981 and cited in 1981-1997 (see also the next note). Van Raan (2006) reports that a power law describes about 16% of the 18,000 publications in Chemistry in the Netherlands during 1991-2000 with a three-year citation window, although no information about the estimated value of ρ is provided.

[13] For the very different 17 phenomena for which a power law cannot be rejected in Clauset *et al.* (2009), in four cases the scaling parameter is below two, in eight cases between two and three, and in five cases above three. In bibliometrics, Redner (1998) reports that α is approximately three for papers published in a single year in a variety of scientific fields with ρ equal to approximately 85 citations, while Lehmann *et al.* (2003) finds that for papers with ρ equal to 50 or more citations in high-energy physics α is equal to 2.31.

In any case, the absence of a universal set of characteristics presents a challenge to any attempt to theoretically explain how such power laws can be formed as a result of the interaction of agents in professional life.

(2) An important question is whether there is some explanation for the failure of a power law in 79 sub-fields. Interestingly enough, when one reviews the characteristics of citation distributions investigated in this paper –namely, size, percentage of zero citations, *h*-index, and coefficient of variation– these 79 sub-fields are indistinguishable from the 140 for which a power law cannot be rejected. Similarly, the distribution of articles into five CSS categories, as well as the percentage of citations they account for, is essentially the same for the two sub-field types (for reasons of space the evidence behind these statements is available on request). Finally, the possibility that highly heterogeneous sub-fields have a greater probability of belonging to the class without a power law has been explored. However, in only seven out of 19 cases this expectation has been confirmed.[14] Thus, we fail to find a systematic reason that explains why some of the 219 WoS categories that constitute the sub-fields in this paper cannot be represented by a power law.

V.3. Results at Higher Aggregation Levels

We know that the existence of power laws at the sub-field level is neither necessary nor sufficient for the appearance of a power law at the next aggregation level. Moreover, it should be remembered that the aggregation procedures in this paper are disturbed by the assignment of articles to multiple sub-fields in about half the sample. As was seen in Section II.2, when two sub-fields, for example, belong to the same discipline, then an article that was wholly counted in each of the sub-fields is counted only once at the discipline level. Be that as it may, it is very interesting to proceed with the empirical study of the aggregation question in our sample. The following five points should be emphasized.

(1) Except for GS disciplines, larger research areas for which the existence of a power law cannot be rejected tend to cover between 70% and 80% of all articles in the sample, a larger percentage than at the sub-field level. Three examples of this tendency are the TvL and TS fields

[14] The upper tail of citation distributions for sub-fields 8, 76, 103, 122, 170, 207, and 216 cannot be represented by a power law, but the opposite is the case for equally heterogeneous or multidisciplinary sub-fields 34, 37, 47, 57, 69, 100, 144, 160, 161 181, 182, 183.

Biology and Biochemistry, Clinical Medicine, and Social Sciences, General, with a significant *p*-value in spite of the fact that in 22 out of 53 sub-fields, five out of twelve, and nine out of 29, respectively, the existence of a power law is rejected. With aggregation, the estimated scaling parameter α tends to slightly increase, while power law size and the percentage of citations they account for tend to decrease. On average, power laws at larger aggregate levels represent less than 1% of all articles and account for about 9% of citations (see Panel B in Table 9 and Figure 3.a, 3.c and 3.d).

(2) Behind this general picture, there are truly intriguing cases. We will review three of them. Firstly, it has been already mentioned that rather large fields may become significant in spite of having a large percentage of sub-fields without a power law. But this phenomenon may arise at a lower level of aggregation. For example, no sub-field within the field of Mathematics in the TvL scheme can be represented by a power law. However, the field as a whole has a *p*-value equal to 0.37. In a similar vein, consider discipline 31 in TvL –Psychiatry and Psychology– which consists of eleven sub-fields. Although six of them do not have a power law, the aggregate presents a *p*-value equal to 0.50.[15] As a final example of the rather unexpected formation of a power law by aggregation, consider the three sub-fields that form discipline 22 in TvL and discipline B0 in GS. In spite of the fact that sub-field 99 –Biology– represents two thirds of the discipline and cannot be represented by a power law, the union with sub-fields 100 and 101 –Biology, Miscellaneous, and Evolutionary Biology– has a *p*-value equal to 0.48.

Secondly, discipline 7 in TvL –Geological Engineering– cannot be represented by a power law in spite of the fact that its two sub-fields –Engineering, Geological, and Mining and Mineral Processing– have a *p*-value of 0.31 and 0.62, respectively. This is an instance in which the evidence shows that perhaps a different aggregation scheme should have been adopted. Similarly, discipline 25 in TvL –Biomedical Sciences– provides an example of an aggregate failing to exhibit power law behavior in spite of the fact that six of its eight sub-fields do. The main culprit is surely sub-field 122 –Medical Research and Experimental– which cannot be represented by a power law, represents about 20% of the discipline, and is characterized by a very high MCR and *h*-index, much greater than those

[15] Ten of the eleven sub-fields, together with three different ones, form discipline N2 in GS –Psychology and Behavioral Sciences– where the same phenomenon is at work.

for the rest of the sub-fields. It might be concluded that perhaps this sub-field was not originally well defined. This is also the problem in three important cases, namely, discipline 2 in TvL and C6 in GS, Materials Science, where the culprit is sub-field 8, Materials Science, Multidisciplinary; discipline G2 in GS, Geosciences and Technology, where the culprit is sub-field 76, Geosciences, Multidisciplinary, and discipline P1 of GS, Applied Physics, where the culprit is sub-field 40, Crystallography.

Thirdly, there are of course several examples in which neither the sub-fields nor the discipline they give rise to can be represented by a power law. This is the case of Immunology, discipline 26 in TvL, as well as disciplines A4 and M4 in GS, Food and Animal Sciences and Technology, and Ophthalmology and Otolaryngology, respectively.

These examples illustrate how subtle the power law algebra turns out to be. After all, peculiarities of citation distributions at their upper tail need not be preserved in response to otherwise sensible aggregation schemes or, on the contrary, they may appear once the appropriate merge of sub-fields has taken place.

(3) Beyond special cases, we must turn our attention towards major phenomena. In particular, anyone would expect that broad, heterogeneous fields can be meaningfully decomposed into a number of disciplines. This is indeed the evidence found in the following four important examples.

• Engineering is a case in point. The breakdown of the field into ten disciplines according to the TvL scheme works very well: except in three disciplines –Electrical Engineering, Materials Science, and the Geological Engineering case already mentioned– the other seven disciplines exhibit power law behavior.

• The breakdown of Chemistry and Physics in the GS scheme is also extremely successful: ten disciplines –five of which are formed by a single sub-field– out of thirteen exhibit power law behavior. Physical Chemistry is one of the three exceptions. Perhaps not surprisingly for the experts, this is due to the large and badly behaved sub-field 59 Chemistry, Physical. The second exception comes from the merge of sub-fields 44 and 45 –Condensed Matter, and Fluids and Plasma– neither of which can be represented by a power law. The relatively heterogeneous discipline of Applied

Physics, where sub-field 42 presents a much greater MCR and *h*-index than the other three sub-fields, constitutes the last exception.

• Another instance of a successful breakdown is the case of the following four fields taken as a whole: Geosciences, Agriculture and Environment, Biology, and Biosciences. In the GS scheme, they give rise to 18 disciplines, 14 of which can be represented by a power law. Among the exceptions, together with the case Food and Animal Sciences already mentioned, we should note the case of discipline B2, Cell Biology, which coincides with the large sub-field 93 characterized by the highest MCR and *h*-index in the entire sample, and the complete absence of evidence about the existence of a power law.

• Finally, Psychiatry and Psychology, together with Neurosciences and Behavioral Sciences can be broken down into three disciplines, all of them clearly represented by a power law.

(4) On the other hand, Panel A in Table 9, as well as some of the specific examples already mentioned, should alert us to the fact that the presence of a power law is not a universal phenomenon at higher aggregation levels. The main problem is found in Biomedical Sciences and Clinical Medicine. Out of the 37 sub-fields included (those numbered 118 to 155), in 16 the existence of a power law must be rejected. This is also the case in 11 of 19 disciplines in the GS scheme (among which the following seven might be noted: Experimental and Laboratory Medicine, Cardiovascular and Respiratory Medicine, Hematology and Oncology, Dermatology and Urogenital System, Ophthalmology and Otolaryngology, Rheumatology and Orthopedics, and Surgery).

(5) The distribution of articles by the 22 TS fields in the original dataset (Table 1 in Albarrán and Ruiz-Castillo, 2011), and in the extended count in this paper (Table A.3 in the Appendix), are essentially the same (Chemistry, Clinical Medicine, and Plan and Animal Science in this paper have 2.7%, 1.6%, and 1.3% fewer articles than in the original dataset, while Biology and Biochemistry, and Physics have here 2.2% and 1% more articles). However, the comparison of the prevalence of power laws in this paper (Table E3 in the Appendix) and in Table 3 in Albarrán and Ruiz-Castillo (2011) yields mixed results. Firstly, there is agreement in 15 cases, including three fields for which both studies cannot find evidence for a power law (Molecular Biology and Genetics, Engineering, and

Agricultural Sciences). It should be noted that in five of the twelve cases in which both studies agree that a power law cannot be rejected, there is a *p*-value difference greater than 0.30. Secondly, contrary to Albarrán and Ruiz-Castillo (2011), there are four cases in which this paper finds that a power law cannot be rejected: the important fields of Chemistry and Physics, as well as Psychiatry and Psychology, and Pharmacology and Toxicology. Finally, the opposite is the case in two fields – Immunology, and Materials Science– where this study does not find evidence for a power law. These results are rather unsatisfactory. One would have preferred a better agreement between the results in Albarrán and Ruiz-Castillo (2011), in which all articles are assigned by TS to a single major field, and this paper, where the extended count is approximately 28% greater. Again, this shows that the presence of a power law is a delicate phenomenon, only partially robust to the multi-assignment of articles even at this high aggregation level. Nevertheless, one wonders what the results would be if TS were to inform of an assignment of each article to a single discipline one aggregation level under the present TS 22 broad fields.

To end this Sub-section, it is of interest to inquire whether for a TS field to have a low percentage of articles assigned to a single WoS category in Table 1 is related to the rejection of a power law. Among the five TS fields for which there is no power law (see Table E2 in the Appendix), in four cases the multi-assignment of articles to sub-fields is much more prevalent than in the sample as a whole. (These fields are Engineering, Materials Science, Molecular Biology and Genetics, and Immunology; the exception is Agricultural Sciences). However, in five fields with a similar high percentage of multi-assignment articles, the existence of a power law cannot be rejected (these are Environment and Ecology, Computer Sciences, Neurosciences and Behavior, Psychiatry and Psychology, and the Social Sciences, General). This seems to indicate that, although the multi-assignment problem might be related to the inexistence of a power law, it is not a sufficient condition to rule out power law behavior for TS field citation distributions.

V.4. A New Aggregation Scheme

The previous discussion suggests the possibility of finding an aggregation scheme that includes favoring a power law as an auxiliary criterion. Naturally, this calls for borrowing the best results found in both schemes. In particular, we take the breakdown of Engineering in TvL, as well as the decomposition of most fields in the GS scheme. Another idea is to subtract from a given discipline the sub-field that has been found responsible for the failure of the power law, as in Biomedical Sciences, Materials Science, Geosciences and Technology, and Applied Physics in the GS scheme. The result of such an attempt is presented in Table F in the Appendix, where the 219 sub-fields are classified into 80 disciplines and 19 fields. The 61 disciplines in the GS scheme, exclusively referring to the natural sciences, have been extended to 71, including three new Engineering disciplines (D47 to D49), two from Clinical Medicine in the TvL scheme (D25 and D26), the Multidisciplinary sub-filed, which becomes discipline D67, and four residual sub-fields, subtracted from as many disciplines to facilitate the appearance of a power law, which become disciplines D68 to D71. Finally, nine disciplines have been added up within the social sciences. All new disciplines, as well as those whose sub-field composition has been modified, are marked with an * in Table F. The extended counts for disciplines and fields are 5,533,524, and 4,991,333 or 46.8% and 32.5% more than the total number of articles in the original sample. These percentages are greater than what is the case for disciplines and fields in the TvL and GS schemes (see Table 2).

New disciplines and new fields present no novelty with respect to the skewness of science according to the CSS technique (to save space, the information on this matter is available on request). Power laws, for which individual information is in Table F, deserve some analysis. The average characteristics of power laws in the new scheme are in Table 9 under the heading New Disciplines and New Fields. In Panel A of that Table, it is observed that a power law cannot be rejected in 59 disciplines and 16 fields, representing 71.8% and 75.5%, respectively, of all articles. The gain is particularly large in the natural sciences (excluding the Social Sciences, the Multidisciplinary field, and some sub-fields in Clinical medicine now grouped in disciplines D35 and D36): 39 GS disciplines accounted for 55.1% of all articles, while this percentage now becomes 74.1%, almost 20 points higher than before.

Orders of magnitude for the different power law parameters are similar to what is recorded in Panel B for other aggregation schemes. Thus, for example, in 25 new disciplines and 8 new fields, representing 42.4% and 50% of all cases where a power law cannot be rejected, the scaling parameter

α is greater than four. On the other hand, on average power laws at the discipline level in this aggregation scheme represent 1.2% of all articles and account for about 10.3% of all citations.

VI. CONCLUSIONS AND EXTENSIONS

VI. 1. Summary of Results

The main results of the paper can be summarized in the following six points.

1. Reference and citation distributions at the sub-field level are very different in size, mean rates, *h*-indices, percentage of zeros, and dispersion indicators. However, as soon as replication and scale invariant indicators are used, it is discovered that, judging by dispersion statistics, the shape of reference and citation distributions over three broad classes of articles are strikingly similar. Using the CSS approach pioneered by Schubert *et al.* (1987), the main aspects of the process by which references made are converted into citations received can be described as follows:

• Reference distributions are moderately skewed (on average, the mean is only 7.4% percentage points above the median, while articles with a remarkable or outstanding number of references that in a uniform distribution would constitute 25% of the total, actually represent 16%; these articles account for 35% of all references).

• As expected, citation distributions are highly skewed (the mean is 20 percentage points above the median, while articles with a remarkable or outstanding number of citations represent about 9% or 10% of the total, and account for approximately 44% of all citations).

2. Since sub-field shapes are so similar, any reasonable aggregation scheme should preserve its main characteristics. This is exactly what is found when sub-fields are aggregated into what we call disciplines and fields according to the schemes suggested by Tijssen and van Leeuwen (2003) and Glänzel and Schubert (2003). Thus, it can be concluded that the celebrated title of Seglen's 1992 contribution appropriately summarizes the massive evidence about citation distributions analyzed in this paper at the level of 219 TS sub-fields, as well as the other categories in these two aggregation schemes.[16]

3. On the other hand, using maximum likelihood estimation methods it can be concluded that the existence of a power law representing citation distributions is a prevalent but not a universal phenomenon: in 140 out of 219 sub-fields, covering about 62% of the total number of articles in the sample, the existence of a power law cannot be rejected. However, it should be emphasized that, when they exist, power laws (i) are much flatter than usually believed, (ii) only represent a small proportion of the upper tail of citation distributions, and (iii) account for a considerable percentage of all citations. Although subject to a large dispersion, on average power laws represent 2% of all articles in a sub-field, and account for about 13.5% of all citations.

4. When moving from the sub-field level to other aggregate categories, we find that the power law algebra operates in a very subtle way: power law behavior at the sub-field level need not be preserved in aggregation; sub-fields for which a power law does not exist may be aggregated into a category for which the existence of a power law cannot be rejected; a single sub-field may be responsible for the power law behavior of a large number of sub-fields to disappear. Heterogeneous broad fields, such as Engineering, Physics, or Chemistry, can be fruitfully partitioned into a number of disciplines, many of which present power law behavior. On the contrary, disciplines in the Biomedical Sciences and Clinical Medicine often fail to be represented by a power law. At any rate, when they exist power laws at aggregate levels tend to be flatter, smaller and accountable for smaller percentages of citations than those at the sub-field level.

5. It is possible to devise an aggregation scheme into reasonable scientific categories that maximizes power law behavior. Using the experience obtained with the TvL and GS schemes, this paper suggests a third one. The existence of a power law cannot be rejected in 59 of 80 disciplines and 16 of 19 fields, accounting for 71.8% and 75.5% of all articles in the respective extended samples.

6. In brief, using a large dataset we have presented convincing systematic evidence about the existence of fundamental regularities in the shape of reference and citation distributions at different

[16] As is well known, the skewness of science in Seglen's paper also refers to other dimensions different from citation distributions.

aggregate levels. This is important because, as anticipated in Albarrán and Ruiz-Castillo (2011), this massive evidence points towards a single theoretical explanation of the decentralized process whereby scientists made references that a few years later translate into a highly skewed citation distribution crowned in many cases by a power law. Recent contributions by, for example, Dorogovtsev and Mendes (2001), Jackson and Rogers (2007), and Peterson *et al.* (2010) constitute a formidable first attempt in this direction. Nevertheless, this paper has also established that when we look into subsets of articles in the lower and upper tails of citation distributions the appearance of relatively large coefficients of variation reveal that the existence of common features partially breaks down. This conclusion contrasts with the more optimistic and universalistic view offered by Radicchi *et al.* (2008), and presents an added challenge, for example, to any attempt at explaining the formation of a power law at the very end of citation distributions.

VI. 2. Extensions

Together with Glänzel (2007a, 2010), Redner (1998, 2005), Lehmann *et al.* (2003, 2008), Van Raan (2006), Radicchi *et al.* (2008), and Albarrán and Ruiz-Castillo (2011), these results provide the most complete evidence available in the Scientometrics literature about the skewness of science and the prevalence of power laws in the citation distributions arising from the academic periodicals indexed by TS (or other comparable periodicals collections). The following issues are left for further research.

a. As indicated in Albarrán and Ruiz-Castillo (2011), from a statistical point of view there are two directions in which this work can be extended. Firstly, the fact that a power law cannot be rejected does not guarantee that a power law is the best distribution to fit the data at the upper tail of citation distributions. New tests must be applied confronting power laws with alternative distributions, such as the lognormal distribution for which Radicchi *et al.* (2008) present some evidence, the escort distribution suggested in Tsallis and de Alburquerque (2000), or other extreme distributions. Secondly, the ML estimation approach used so far might be quite vulnerable to the existence of a few, but potentially influential extreme observations consisting of a small set of highly cited articles. Consequently, robust estimation methods are worthwhile exploring. In addition, a dynamic model of the citation process may allow us to select variable citation windows to ensure that a common percentage of the process is completed in all distributions in the dataset. This may strengthen the similarities at the lower tail of citation distributions.

b. It has been observed that, when a power law is present, it only covers a relatively small percentage of articles. Therefore, the rest of the citation distribution needs to be systematically studied. For the results obtained taking a global and macroscopic perspective, see Wallace *et al.* (2009), as well as the references quoted there. Also, given the parallelism between citation distributions and income distributions (articles are interchangeable with individuals, and citations with incomes), a reasonable suggestion is to apply in Scientometrics the same statistical methods that have been proved useful in Economics (see *inter alia*, Kleiber and Kotz, 2003).

c. The abundance of sub-fields motivates the search for schemes that allows us to work with a smaller number of aggregate categories. This paper has studied the consequences of different aggregation procedures for the distribution of articles into citation categories, and for the existence of a power law representing the very upper tail of citation distributions. However, it remains to be investigated whether the upper tail of aggregate categories is a fair mix of the upper tail of the constituent sub-fields, or whether it is dominated by a single sub-field or a small subset of them.

d. At present, the assignment of articles to sub-fields is often done through the assignment of the journals where the articles are published. In the TS case, this leads to 42% of all articles being assigned to two or more sub-fields. In the multiplicative strategy followed in this paper, where each article is wholly counted as many times as sub-fields it is assigned to, the resulting extended count is 57% larger than the number of articles in the original dataset. Naturally, since the extent of the multi-assignment problem decreases as we proceed upwards in the aggregation scheme, there exists a different extended count at every aggregation level. This breaks down the natural connection between aggregation levels, a fact that may not affect much the results on the skewness of science using the CSS approach, but it may have unknown consequences for power law behavior across aggregation levels, and it may also affect other research in which aggregation issues are critical. To solve this problem, it is crucial to construct schemes in which each article is directly assigned to a single sub-field (see *inter alia*, Glänzel and Schubert, 2003, and Waltman *et al.*, 2010) on the basis of its references, its key words, and other techniques that may include the testing for the existence of a power law. The obvious difficulty of truly interdisciplinary research belonging to several very closely related sub-fields might be solved by creating new mixed sub-fields containing them.[17] In turn, for research in aggregation issues it would be extremely convenient if each sub-field were assigned to a single discipline, and each discipline to a single field, on the basis of experts' opinions, as well as bibliometric techniques that may include the preservation, or generation as the case may be, of power law behavior.

[17] We have carried out the following naïve experiment with our TS dataset. First, articles belonging to a single WoS constitute a first sub-field type. Next, articles belonging to two WoS categories constitute a second sub-field type. And so on until the case of articles belonging to a six WoS categories is reached. This purely mechanical procedure gives rise to 2,239 sub-fields, many of which are too small for statistical analysis. However, using bibliometric criteria to assign individual articles to sub-fields, the number of sub-fields involved might be reduced to manageable proportions.

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Table 1. Assignment of Articles to One or Multiple Web of Science Categories (Sub-fields) By TS Field, 1998-2002 Database

		Number of WoS Categories or Sub-fields						
		1	**2**	**3**	**4**	**5**	**6**	**Total**
	LIFE SCIENCES	**873,903**	**438,548**	**155,849**	**33,640**	**4,052**	**842**	**1,506,834**
		58.0	**29.1**	**10.3**	**2.2**	**0.3**	**0.1**	**100.0**
		39.8	**40.3**	**42.0**	**33.0**	**40.9**	**54.9**	**40.0**
(1)	**Clinical Medicine**	508,392	196,212	69,436	14,563	1,586	842	**791,031**
		64.3	24.8	8.8	1.8	0.2	0.1	**100.0**
		23.2	18.0	18.7	14.3	16.0	54.9	**21.00**
(2)	**Biology & Biochemistry**	128,388	68,814	26,320	4,289	1,080	0	**228,891**
		56.1	30.1	11.5	1.9	0.5	0.0	**100.0**
		5.8	6.3	7.10	4.2	10.9	0.0	**6.1**
(3)	**Neuroscience & Behavioral**	53,313	44,572	15,913	1,864	363	0	**116,025**
		45.9	38.4	13.7	1.6	0.3	0.0	**100.0**
		2.4	4.1	4.3	1.8	3.7	0.0	**3.1**
(4)	**Molecular Biology & G**	44,622	42,184	13,710	2,284	0	0	**102,800**
		43.4	41.0	13.3	2.2	0.0	0.0	**100.0**
		2.0	3.9	3.7	2.2	0.0	0.0	**2.7**
(5)	**Psychiatry & Psychology**	43,692	29,737	10,126	7,327	1,023	0	**91,905**
		47.5	32.4	11.0	8.0	1.1	0.0	**100.0**
		2.0	2.7	2.7	7.2	10.3	0.0	**2.4**
(6)	**Pharmacology & Toxicology**	35,260	19,725	8,306	964	0	0	**64,255**
		54.9	30.7	12.9	1.5	0.0	0.0	**100.0**
		1.6	1.8	2.2	0.9	0.0	0.0	**1.7**
(7)	**Microbiology**	35,605	21,043	1,940	2,166	0	0	**60,754**
		58.6	34.6	3.2	3.6	0.0	0.0	**100.0**
		1.6	1.9	0.5	2.1	0.0	0.0	**1.6**
(8)	**Immunology**	24,631	16,261	10,098	183	0	0	**51,173**
		48.1	31.8	19.7	0.4	0.0	0.0	**100.0**
		1.1	1.5	2.7	0.2	0.0	0.0	**1.4**
	PHYSICAL SCIENCES	**702,781**	**265,265**	**72,429**	**13,938**	**1,418**	**258**	**1,056,089**
		66.5	**25.1**	**6.9**	**1.3**	**0.1**	**0.0**	**100**
		32.0	**24.4**	**19.5**	**13.7**	**14.3**	**16.8**	**28.0**
(9)	**Chemistry**	311,828	110,628	29,166	6,011	529	211	**458,373**
		68.0	24.1	6.4	1.3	0.1	0.1	**100.0**
		14.2	10.2	7.9	5.9	5.3	13.8	**12.2**
(10)	**Physics**	237,545	103,138	32,113	2,276	0	0	**375,072**
		63.3	27.5	8.6	0.6	0.0	0.0	**100.0**
		10.8	9.5	8.7	2.2	0.0	0.0	**10.0**
(11)	**Computer Science**	34,681	29,379	8,217	2,915	889	47	**76,128**
		45.6	38.6	10.8	3.8	1.2	0.1	**100.0**

		1.6	2.7	2.2	2.8	9.0	3.1	**2.0**
(12)	**Mathematics**	74,531	20,188	2,387	75	0	0	**97,181**
		76.7	20.8	2.5	0.1	0.0	0.0	**100.0**
		3.4	1.8	0.6	0.1	0.0	0.0	**2.6**
(13)	**Space Science**	44,196	1,932	546	2,661	0	0	**49,335**
		89.6	3.9	1.1	5.4	0.0	0.0	**100.0**
		2.0	0.2	0.1	2.6	0.0	0.0	**1.3**
	OTHER NATURAL SCI	**506,231**	**302,889**	**125,554**	**47,696**	**3,100**	**433**	**985,903**
		51.3	**30.7**	**12.7**	**4.8**	**0.3**	**0.0**	**100.0**
		23.1	**27.8**	**33.9**	**46.7**	**31.3**	**28.2**	**26.2**
(14)	**Engineering**	131,375	112,410	45,574	24,580	2,930	433	**317,302**
		41.4	35.4	14.4	7.7	0.9	0.1	**100.0**
		6.0	10.3	12.3	24.2	29.5	28.2	**8.4**
(15)	**Plant & Animal Science**	142,483	57,384	13,036	5,482	0	0	**218,385**
		65.2	26.3	6.0	2.5	0.0	0.0	**100.0**
		6.5	5.3	3.5	5.4	0.0	0.0	**5.8**
(16)	**Materials Science**	71,712	62,042	22,113	12,725	132	0	**168,724**
		42.5	36.8	13.1	7.5	0.1	0.0	**100.0**
		3.3	5.7	6.0	12.5	1.3	0.0	**4.5**
(17)	**Geosciences**	67,640	24,624	7,207	2,274	38	0	**101,783**
		66.5	24.2	7.1	2.2	0.0	0.0	**100.0**
		3.1	2.3	1.9	2.2	0.4	0.0	**2.7**
(18)	**Environment & Ecology**	33,800	28,370	26,291	2,059	0	0	**90,520**
		37.3	31.3	29.0	2.3	0.0	0.0	**100.0**
		1.5	2.6	7.1	2.0	0.0	0.0	**2.4**
(19)	**Agricultural Sciences**	40,144	17,430	10,893	576	0	0	**69,043**
		58.1	25.2	15.8	0.8	0.0	0.0	**100.0**
		1.8	1.6	2.9	0.6	0.0	0.0	**1.8**
(20)	**Multidisciplinary**	19,077	629	440	0	0	0	**20,146**
		94.7	3.1	2.2	0.0	0.0	0.0	**100.0**
		0.9	0.1	0.1	0.0	0.0	0.0	**0.5**
	SOCIAL SCIENCES	**111,473**	**82,072**	**19,878**	**6,780**	**1,349**	**0**	**218,552**
		51.0	**37.6**	**7.7**	**3.1**	**0.6**	**0.0**	**100.0**
		5.1	**7.5**	**4.6**	**6.6**	**13.6**	**0.0**	**5.8**
(21)	**Social Sciences, General**	75,102	62,636	11,048	5,258	1,349	0	**155,393**
		48.3	40.3	7.1	3.4	0.9	0.0	**100.0**
		3.4	5.7	3.0	5.1	13.6	0.0	**4.1**
(22)	**Economics & Business**	36,371	19,436	5,830	1,522	0	0	**63,159**
		57.6	30.8	9.2	2.4	0.0	0.0	**100.0**
		1.7	1.8	1.6	1.5	0.0	0.0	**1.7**
	ALL SIENCES	**2,194,388**	**1,088,774**	**370,710**	**102,054**	**9,919**	**1,533**	**3,767,378**

58.2	28.9	9.8	2.7	0.3	0.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2. Extended Counts

	Number of Articles	
Original Dataset	**3,767,378**	**100.0**
EXTENDED COUNTS:		
TS (Thomson Scientific) Sub-fields	5,909,510	156.9
TvL (Tijssen and van Leeuwen) Disciplines	5,158,685	136.9
TvL Fields	4,671,265	124.0
TS Fields	4,814,975	127.8
Original Dataset, Natural Sciences*	**3,528,380**	**100.0**
EXTENDED COUNTS:		
GS (Glänzel and Schubert) Disciplines	5,073,141	143.8
GS Fields	4,524,879	120.2

* This is an approximate reference (see the Appendix for the details), equal to the Original TS Dataset – (Social Sciences + Multidisciplinary)

Table 3. Size of Citation Distributions At All Aggregation Levels

AGGREGATION LEVEL	Mean	Standard Deviation	Inter-quantile Range/Median
• **219 TS Sub-fields**	26,984	29,669	1.6
• **61 GS Disciplines**	83,166	51,709	0.8
• **38 TvL Disciplines**	135,755	127,645	1.1

Table 4. References Made and Citations Received At the TS Sub-field Level

REFERENCE DISTRIBUTIONS' CHARACTERISTICS:	Mean	Standard Deviation	Inter-quantile range/Median
• % Zero References	4.9	8.9	2.0
• Mean Reference Rate	26.3	7.8	0.4
• *h*-index	88.6	15.4	0.2
• Coefficient of Variation	0.7	0.2	0.2
• Ratio References/Citations	6.1	4.1	0.7
CITATION DISTRIBUTIONS' CHARACTERISTICS:			
• % Zero Citations	24.7	13.9	0.8
• Mean Citation Rate	5.7	3.5	0.8
• *h*-index	61.2	43.6	0.9
• Coefficient of Variation	1.7	0.7	0.3

• Sub-field Size

Table 5. Characteristics of Citation Distributions At Different Aggregation Levels Distributions

CHARACTERISTICS	Mean	Standard Deviation	Inter-quantile range/Median
1. % ZERO CITATIONS			
• 61 GS Disciplines	19.2	8.9	0.5
• 38 TvL Disciplines	25.8	13.5	0.9
• 22 TS Fields	22.2	11.4	1.1
• 12 TvL Fields	25.5	12.3	1.0
• 12 GS Fields	20.1	8.7	0.5
2. % MEAN CITATION RATE			
• 61 GS Disciplines	7.5	3.7	0.5
• 38 TvL Disciplines	6.2	3.9	0.9
• 22 TS Fields	7.3	4.1	1.0
• 12 TvL Fields	6.2	3.4	0.8
• 12 GS Fields	7.6	3.4	0.5
3. COEFFICIENT OF VARIATION			
• 61 GS Disciplines	1.7	0.5	0.2
• 38 TvL Disciplines	1.9	0.7	0.2
• 22 TS Fields	1.9	0.7	0.2
• 12 TvL Fields	2.2	0.8	0.3
• 12 GS Fields	2.0	0.6	0.3
4. *h*-INDEX			
• 61 GS Disciplines	105.9	54.8	0.6
• 38 TvL Disciplines	108.3	69.1	1.0
• 22 TS Fields	135.8	70.3	0.6
• 12 TvL Fields	155.2	85.0	1.1
• 12 GS Fields	175.6	72.1	0.5

TS = Thomson Scientific

GS = Glänzel and Schubert

TvL = Tijssen and van Leeuwen

Table 6. Characteristic Scores and Scales. Means (and Standard Deviations)

	Percentage Of Articles In Categories:		Percentage of References In Categories:	
	1 + 2	**4 + 5**	**2**	**4 + 5**
A. TS SUB-FIELDS				
Reference Distributions	57.5 (3.1)	16.0 (1.8)	31.3 (5.3)	35.0 (4.6)
			Percentage of Citations In Categories:	
Citation Distributions	68.6 (3.7)	10.0 (1.7)	21.1 (5.0)	44.9 (4.6)
	Percentage Of Articles In Categories:		**Percentage of Citations In Categories:**	
CITATION DISTRIBUTIONS:				
B. TvL SCHEME				
Disciplines	69.5 (2.8)	9.3 (1.5)	20.4 (5.2)	45.6 (4.3)
Fields	70.3 (2.7)	9.0 (1.5)	20.6 (4.0)	46.1 (3.5)
C. TS SCHEME				
Fields	69.7 (2.6)	9.2 (1.3)	21.6 (4.1)	44.7 (3.6)
D. GS SCHEME				
Disciplines	68.8 (3.0)	9.8 (1.4)	22.6 (3.1)	43.8 (2.9)
Fields	69.7 (1.8)	8.9 (0.7)	22.2 (2.4)	43.8 (1.8)

GLÄNZEL AND SCHUBERT DISCIPLINES

<u>Number of Citations</u>:

(see the main text for a complete explanation)

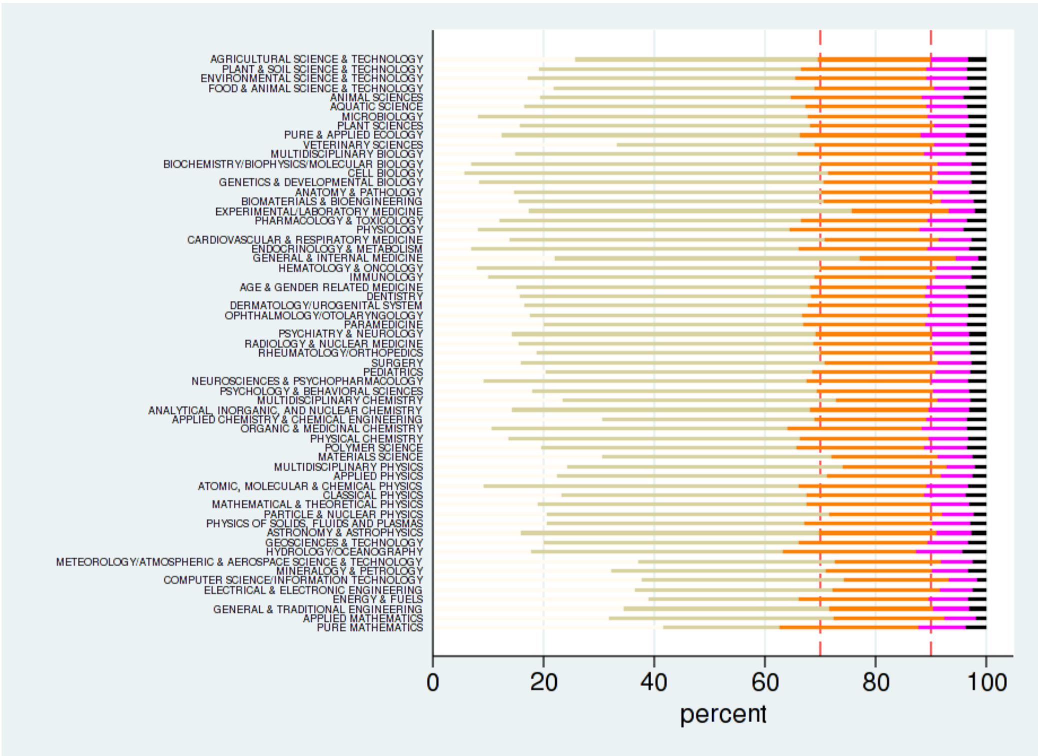

Figure 1. Citations Received By Articles Published In 1998-2002 With a Five-year Citation Window

TIJSSEN AND VAN LEEUWEN DISCIPLINES

__Number of Citations__:

(see the main text for a complete explanation)

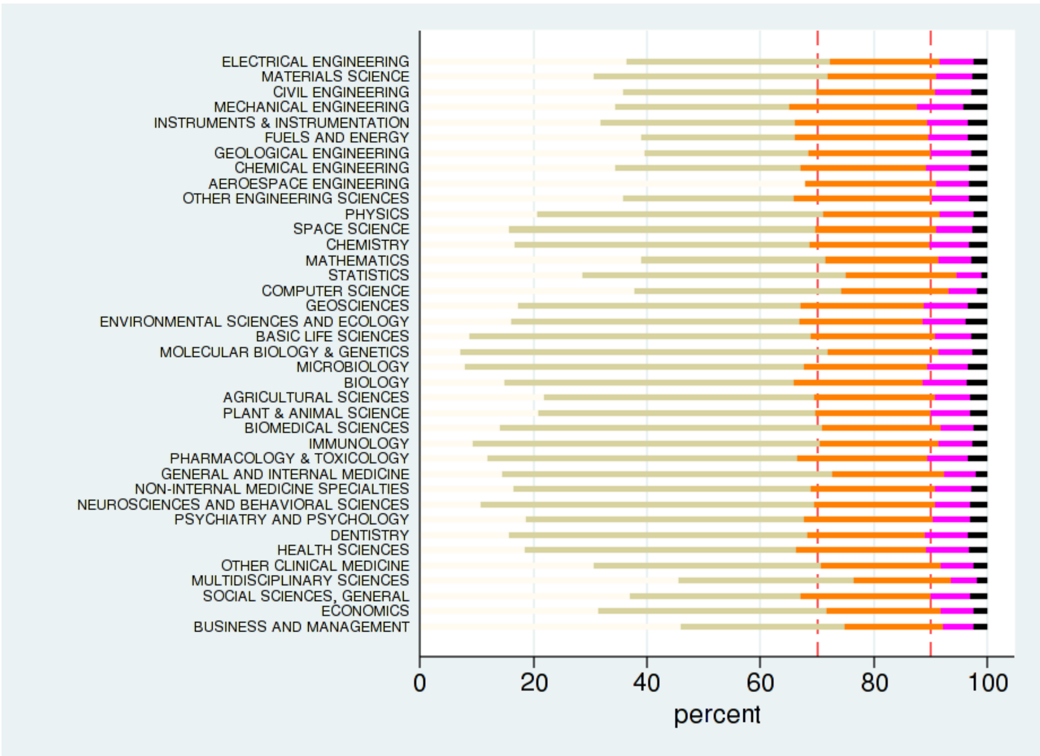

Figure 2. Citations Received By Articles Published In 1998-2002 With a Five-year Citation Window

Table 7. Mean Values (and Standard Deviations) of the Characteristic Score S_3 and Its Normalized Version S_3* At Different Aggregation Levels

	Means (and Standard Deviations)	
	S_3	S_3*
219 TS Sub-fields	25.8 (18.3)	3.0 (0.2)
38 TvL Disciplines	30.1 (18.5)	3.0 (0.2)
12 TvL Fields	30.8 (14.9)	3.1 (0.1)
22 TS Fields	34.8 (19.0)	3.1 (0.1)
61 GS Disciplines	34.6 (19.8)	3.1 (0.2)
12 GS Fields	36.9 (16.7)	3.1 (0.1)

$\mathbf{S_3}$ = Mean citation rate of articles with citations above $\mathbf{S_2}$, where $\mathbf{S_2}$ = Mean citation rate of articles with citations above the distribution's mean citation rate, i. e. above $\mathbf{S_1}$.

$S_3* = S_3/(S_2 - S_1) = \mathbf{S_3}$ normalized value.

Table 8. Percentage of publications in each sub-field that appear in the top z% of the global rank, together with the standard deviation, σ_z, and the coefficient of variation, σ_z/z

Theoretical Values			Empirical Values In:					
			Normalized Distribution			Original Distribution		
z%	σ_z	σ_z/z	z%	σ_z	σ_z/z	z%	σ_z	σ_z/z
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	0.11	0.11	0.98	0.54	0.55	0.51	1.01	1.98
3	0.19	0.06	3.06	0.98	0.32	1.68	2.48	1.47
5	0.24	0.05	5.14	1.10	0.21	3.02	3.79	1.25
10	0.33	0.03	10.40	1.28	0.12	6.36	6.32	0.99
20	0.44	0.02	20.60	2.26	0.11	15.04	10.98	0.73
30	0.50	0.02	30.51	3.61	0.12	22.38	13.59	0.61
40	0.54	0.01	41.00	5.75	0.14	30.09	15.47	0.51
75	0.47	0.01	73.40	12.83	0.17	60.91	16.44	0.27

Table 9. Power Law Estimation Results

PANEL A. CASES WHERE THE EXISTENCE OF A POWER LAW CANNOT BE REJECTED

	Number of Items/Total (Percentage of the Total) (1)	Percentage of Articles In % (2)
TS Sub-fields	140/219 (63.9)	61.9
TvL Disciplines	26/38 (68.4)	71.5
TvL Fields	9/12 (75)	72.8
TS Fields	17/22 (77.3)	80.5
GS Disciplines	39/61 (63.9)	55.1
GS Fields	9/11 (81.8)	71.3
New Disciplines	59/80 (73.8)	71.8
New Fields	16/19 (84.2)	75.5

PANEL B. POWER LAW CHARACTERISTICS

	$\alpha \leq 3$ (1)	$\alpha \in (3, 4]$ (2)	$\alpha > 4$ (3)	Power Law As % Total Number Of Articles (4)	% Citations Accounted For Power Laws (5)
TS Sub-fields	4 (2.86)	80 (57.14)	56 (40.00)	2.09 (2.74)	13.49 (13.53)
TvL Disciplines	0 (0.00)	13 (50.00)	13 (50.00)	0.78 (0.90)	8.38 (7.67)
TvL Fields	0 (0.00)	6 (66.67)	3 (33.33)	0.75 (0.92)	9.60 (9.32)
TS Fields	0 (0.00)	8 (47.06)	9 (52.94)	0.80 (0.81)	9.30 (8.29)
GS Disciplines	1 (2.56)	20 (51.28)	18 (46.15)	1.11 (1.43)	8.77 (8.29)
GS Fields	0 (0.00)	5 (55.56)	4 (44.44)	0.52 (0.58)	6.92 (6.81)

New Disciplines	1 (1.69)	33 (55.93)	25 (42.37)	1.20 (1.33)	10.34 (8.22)
New Fields	0 (0.00)	8 (50.00)	8 (50.00)	0.63 (0.54)	8.33 (6.61)

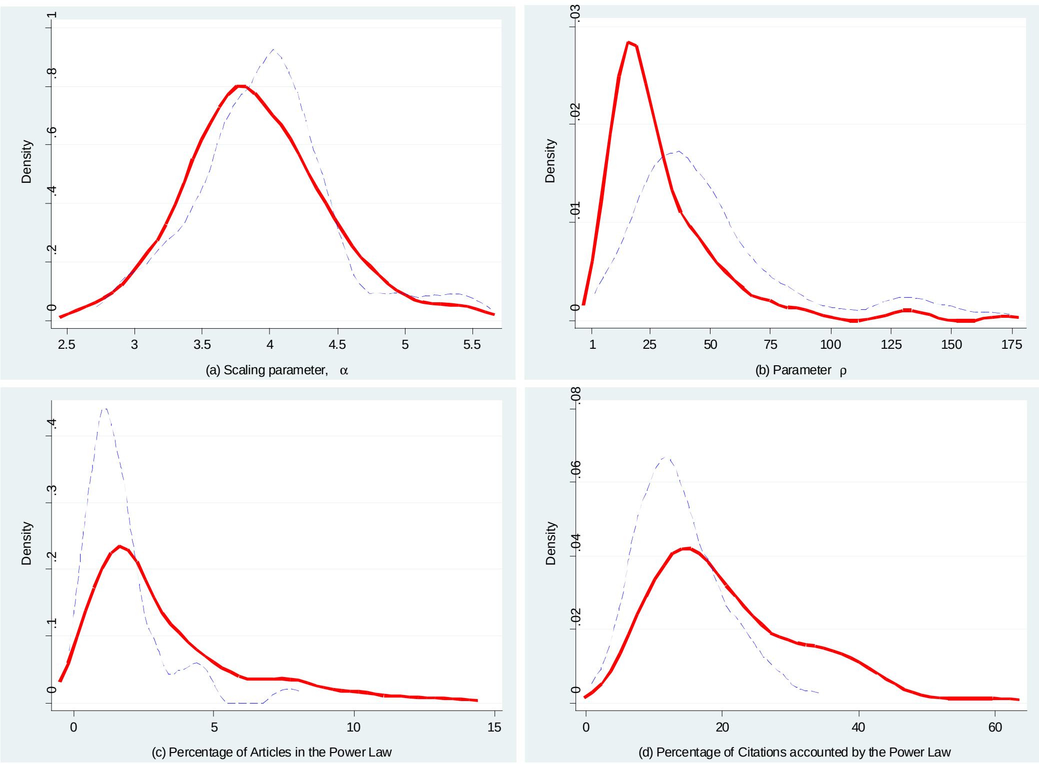

Figure 3. Power Laws Characteristics Across TS Sub-fields (Red/Solid Thick Line) and GS Disciplines (Blue/Dashed Thin Line)

APPENDIX

I. A Map of Science Inspired in Tijssen and van Leeuwen (2003)

The hierarchical classification system proposed by these authors is designed to provide an internationally acceptable division in areas and sub-areas to be used in the *Third European Report on Science and Technology Indicators*. It consists of three layers: 12 broad scientific fields, 27 disciplines, and 178 sub-fields. The sub-fields and disciplines are identical to those used by the *Center for Science and Technology* Studies (CWTS) of the Leiden University in the Netherlands for various macro-level bibliometric studies.

Our TS database distinguishes among 219 sub-fields and 22 fields. In an attempt to integrate this reality into the TvL scheme, we have found convenient to extend their 27 disciplines into 38 as follows:

1. The five disciplines called Biology, Agricultural and Food Science, Basic Life Sciences, Biomedical Sciences, and Pharmacology in TvL, have become nine (numbered 19 to 27 in the map below), including the four new ones: Molecular Biology and Genetics (20), Microbiology (21), Plant and Animal Sciences (24), and Immunology (26).

2. The three disciplines Clinical Medicine, Health Sciences, and Dentistry in TvL, have become seven by dividing Clinical Medicine into General and Internal Medicine and Non-Internal Specialties (numbers28 and 29) –a distinction we have borrowed from the GS scheme–, and by including the following three new ones: Neurosciences and Behavioral Sciences (30), Psychiatry and Psychology (31), and a residual discipline, called Other Clinical Medicine (34), which includes two sub-fields not covered before (Education, Scientific Disciplines, and Medical Informatics).

3. For the sake of completeness within the TS framework, we have included three new disciplines within the Social Sciences: Social Sciences, general (36), Economics (37), and Business and Management (38). It should be noted that the sub-field Social Sciences, Mathematical Methods that is in the discipline Statistics in TvL, is now assigned to Economics.

As far as fields is concerned, we have been unable to maintain those of Biological Sciences (field vii), Basic Life Sciences (ix), and Biomedical Sciences (x) in TvL, which in our scheme become only two: Biology and Biochemistry (VII), and Biomedical Sciences (IX). Since we have created a new one, namely, Social Sciences, our version of the TvL scheme remains with 12 fields. These 12 fields are expanded into the 22 distinguished in TS as follows:

1. Engineering becomes two fields: Engineering and Materials Science.

2. Physics becomes two fields: Physics and Space Science.

3. Earth and Environmental becomes two fields: Geosiences, and Environmental Science and Ecology.

4. The four fields Biological Sciences, Agriculture and Food Sciences, Basic Life Sciences, and Biomedical Sciences become seven: Biology and Biochemistry, Molecular Biology and Genetics, Pharmacology and Toxicology, Microbiology, Immunology, Agricultural Sciences, and Plant and Animal Science.

5. Clinical Medicine becomes three fields: Clinical Medicine, Neurosciences and Behavioral Sciences, and Psychiatry and Psychology.

6. Social Sciences become Social Sciences, General, and Economics and Business.

Table A1. Distribution of Articles By Thomson Scientific Sub-fields, According to the TvL (Tijssen and van Leeuwen) Scheme. Articles Published in 1998-2002

	Number of Articles		
	Sub-fields (1)	**Disciplines (2)**	**FIELDS (3)**
i. ENGINEERING			**657,156**
1. Electrical Engineering		**129,184**	
1. Engineering, Electrical & Electronic	124,872		
2 Telecommunications	23,341		
2. Materials Science		**225,937**	
3 Materials Science, Biomaterials	6,570		
4 Materials Science, Ceramics	20,067		
5. Materials Science, Characterization & Testing	6,605		
6 Materials Science, Coatings & Films	22,284		
7 Materials Science, Composite	9,566		
8 Materials Science, Multidisciplinary	137,363		
9 Materials Science, Paper & Wood	7,273		
10 Materials Science, Textiles	5,149		
11 Metallurgy & Metallurgical Engineering	41,039		
12 Nanoscience & Nanotechnology	19,199		
3. Civil Engineering		**49,560**	
13 Construction & Building Technology	8,820		
14 Engineering, Civil	23,153		
15 Engineering, Environmental	21,097		
16 Engineering, Marine	2,793		
17 Transportation Science & Technology	6,022		
4. Mechanical Engineering		**97,075**	
18 Engineering, Industrial	14,160		
19 Engineering, Manufacturing	14,497		
20 Engineering, Mechanical	41,254		
21 Mechanics	43,470		
22 Robotics	3,208		
5. Instruments		**48,666**	
23 Instruments & Instrumentation	40,354		
24 Microscopy	3,992		
25 Imaging Science & Photographic Technology	4,897		
6. Fuels and Energy		**68,928**	

26 Energy & Fuels	30,104		
27 Nuclear Science & Technology	36,780		
28 Engineering, Petroleum	11,542		
7. Geological Engineering		**11,473**	
29 Engineering, Geological	4,650		
30 Mining & Mineral Processing	7,360		
8. Chemical Engineering		**67,230**	
31 Engineering, Chemical	67,230		
9. Aerospace Engineering		**20,377**	
32 Engineering, Aerospace	20,377		
10. Other Engineering		**73,399**	
33 Automation & Control Systems	17,335		
34 Engineering, Multidisciplinary	22,817		
35 Engineering, Ocean	3,470		
36 Ergonomics	3,041		
37 Mathematics, Interdisciplinary Applications	17,566		
38 Operations Research & Management Science	18,629		
ii. PHYSICS AND ASTRONOMY			**587,109**
11 Physics		**539,547**	
39 Acoustics	14,675		
40 Crystallography	28,320		
41 Optics	53,608		
42 Physics, Applied	126,236		
43 Physics, Atomic, Molecular & Chemical	60,889		
44 Physics, Condensed Matter	106,896		
45 Physics, Fluids & Plasmas	24,110		
46 Physics, Mathematical	33,785		
47 Physics, Multidisciplinary	83,795		
48 Physics, Nuclear	25,345		
49 Physics, Particles & Fields	39,308		
50 Spectroscopy	29,836		
51 Thermodynamics	17,689		
12. Space Science		**59,843**	
52 Astronomy & Astrophysics	59,843		
iii. CHEMISTRY			**491,722**
13. Chemistry		**491,722**	
53 Chemistry, Analytical	67,870		
54 Chemistry, Applied	34,686		
55 Chemistry, Inorganic & Nuclear	48,939		

56 Chemistry, Medicinal	24,515		
57 Chemistry, Multidisciplinary	101,864		
58 Chemistry, Organic	77,870		
59 Chemistry, Physical	125,544		
60 Electrochemistry	20,266		
61 Polymer Science	57,159		
iv. MATHEMATICS			**124,023**
14. Mathematics		**103,472**	
62 Mathematics	66,308		
63 Mathematics, Applied	53,017		
15. Statistics		**23,229**	
64 Statistics & Probability	23,229		
v. COMPUTER SCIENCE			**120,147**
16. Computer Science		**120,147**	
65 Computer Science, Artificial Intelligence	23,740		
66 Computer Science, Cybernetics	4,694		
67 Computer Science, Hardware & Architecture	13,256		
68 Computer Science, Information Systems	21,158		
69 Computer Science, Interdisciplinary Applications	27,529		
70 Computer Science, Software Engineering	18,926		
71 Computer Science, Theory & Methods	33,333		
72 Mathematical & Computational Biology	7,409		
vi. EARTH & ENVIRONMENT			**240,255**
17. Geosciences		**128,359**	
73 Geochemistry & Geophysics	26,133		
74 Geography, Physical	8,824		
75 Geology	7,846		
76 Geosciences, Multidisciplinary	46,211		
77 Meteorology & Atmospheric Sciences	27,409		
78 Mineralogy	7,415		
79 Oceanography	19,217		
80 Paleontology	6,629		
81 Remote Sensing	5,027		
18. Environment Sciences & Ecology		**132,631**	
82 Biodiversity Conservation	6,528		
83 Ecology	40,881		
84 Environmental Sciences	70,700		
85 Limnology	5,513		
86 Soil Science	14,237		

87 Water Resources	25,750		
vii. BIOLOGY & BIOCHEMISTRY			**487,814**
19. Basic Life Sciences		**311,993**	
88 Biochemical Research Methods	33,589		
89 Biochemistry & Molecular Biology	213,448		
90 Biophysics	48,861		
91 Biotechnology & Applied Microbiology	64,772		
92 Reproductive Biology	16,676		
20. Molecular Biology & Genetics		**150,237**	
93 Cell Biology	83,777		
94 Genetics & Heredity	62,866		
95 Developmental Biology	16,822		
21. Microbiology		**86,780**	
96 Microbiology	56,148		
97 Parasitology	10,815		
98 Virology	20,557		
viii. AGRICULTURE & FOOD SCIENCES			**325,477**
22. Biology		**35,878**	
99 Biology	24,484		
100 Biology, Miscellaneous	423		
101 Evolutionary Biology	10,971		
23. Agricultural Sciences		**97,993**	
102 Agricultural Engineering	4,386		
103 Agriculture, Multidisciplinary	14,772		
104 Agronomy	23,691		
105 Food Science & Technology	44,708		
106 Nutrition & Dietetics	22,023		
24. Plant & Animal Sciences		**244,747**	
107 Agriculture, Dairy & Animal Science	21,730		
108 Entomology	19,359		
109 Fisheries	15,539		
110 Forestry	11,061		
111 Horticulture	10,080		
112 Marine & Freshwater Biology	32,289		
113 Mycology	5,945		
114 Ornithology	4,348		
115 Plant Sciences	63,921		
116 Veterinary Sciences	51,650		
117 Zoology	33,580		

ix. BIOMEDICAL SCIENCES			**399,702**
25. Biomedical		**198,261**	
118 Anatomy & Morphology	6,114		
119 Andrology	1,428		
120 Engineering, Biomedical	19,413		
121 Medical Laboratory Technology	10,317		
122 Medicine, Research & Experimental	43,246		
123 Pathology	29,076		
124 Physiology	43,378		
125 Radiology, Nuclear Medicine & Medical Imaging	54,431		
26. Immunology		**97,831**	
126 Immunology	81,689		
127 Infectious Diseases	32,212		
27. Pharmacology & Toxicology		**124,416**	
128 Pharmacology & Pharmacy	101,509		
129 Toxicology	30,778		
x. CLINICAL MEDICINE			**994,502**
28. General & Internal Medicine		**352,501**	
130 Allergy	9,133		
131 Cardiac & Cardiovascular Systems	55,264		
132 Emergency Medicine	6,830		
133 Endocrinology & Metabolism	48,723		
134 Gastroenterology & Hepatology	35,304		
135 Hematology	41,982		
136 Medicine, General & Internal	65,120		
137 Oncology	80,976		
138 Respiratory System	28,392		
139 Tropical Medicine	6,858		
29. Non-internal Medicine		**373,168**	
140. Anesthesiology	16,884		
141. Critical Care Medicine	13,246		
142. Dermatology	21,489		
143. Geriatrics & Gerontology	9,448		
144. Integrative & Complementary Medicine	2,511		
145. Obstetrics & Gynecology	32,587		
146. Ophthalmology	26,205		
147. Orthopedics	24,353		
148. Otorhinolaryngology	17,583		
149. Pediatrics	42,958		

150. Peripheral Vascular Disease	36,793		
151. Rheumatology	10,668		
152. Sport Sciences	21,023		
153. Surgery	104,727		
154. Transplantation	21,179		
155. Urology & Nephrology	33,713		
30. Neurosiences & Behavior		**174,865**	
156. Behavioral Sciences	14,569		
157. Clinical Neurology	67,356		
158. Neuroimaging	6,294		
159. Neurosciences	110,738		
160. Psychology, Biological	4,015		
161. Social Sciences, Biomedical	6,365		
31. Psychiatry & Psychology		**121,854**	
162. Psychiatry	43,699		
163. Psychology	16,239		
164. Psychology, Applied	8,837		
165. Psychology, Clinical	18,050		
166. Psychology, Developmental	10,085		
167. Psychology, Educational	5,376		
168. Psychology, Experimental	15,701		
169. Psychology, Mathematical	1,760		
170. Psychology, Multidisciplinary	18,987		
171. Psychology, Psychoanalysis	2,490		
172. Psychology, Social	9,726		
32. Dentistry		**21,077**	
173. Dentistry & Oral Surgery	21,077		
33. Health Sciences		**98,541**	
174. Health Care Sciences & Services	14,691		
175. Health Policy & Services	9,847		
176. Medicine, Legal	4,382		
177. Nursing	9,112		
178. Public, Environmental & Occupational Health	50,526		
179. Rehabilitation	14,159		
180. Substance Abuse	7,843		
34. Other Clinical Medicine		**14,644**	
181. Education, Scientific Disciplines	8,207		
182. Medical Informatics	6,437		
xi. MULTIDISCIPLINARY			**31,984**

35. Multidisciplinary		**31,984**	
183. Multidisciplinary Sciences	31,984		
xii. SOCIAL SCIENCES			**211,374**
36. General		**154,562**	
184. Anthropology	7,680		
185. Area Studies	4,260		
186. Communication	5,120		
187. Criminology & Penology	3,653		
188. Demography	2,316		
189. Education & Educational Research	16,608		
190. Education, Special	3,037		
191. Environmental Studies	9,950		
192. Ethics	4,771		
193. Ethnic Studies	893		
194. Family Studies	5,219		
195. Geography	5,575		
196. Gerontology	6,962		
197. History Of Social Sciences	1,677		
198. Information Science & Library Science	10,811		
199. International Relations	7,951		
200. Law	13,210		
201. Linguistics	6,398		
202. Medical Ethics	1,100		
203. Planning & Development	6,889		
204. Political Science	16,978		
205. Public Administration	3,773		
206. Social Issues	5,198		
207. Social Sciences, Interdisciplinary	9,216		
208. Social Work	4,920		
209. Sociology	13,033		
210. Transportation	1,925		
211. Urban Studies	4,717		
212. Women's Studies	3,946		
37. Economics		**40,493**	
213. Agricultural Economics & Policy	1,769		
214. Economics	37,138		
215. Industrial Relations & Labor	2,264		
216. Social Sciences, Mathematical Methods	5,425		
38. Business & Management		**36,081**	

217. Business	13,062		
218. Business, Finance	12,640		
219. Management	14,130		
ALL SUB-FIELDS	**5,909,510**		
ALL DISCIPLINES		**5,158,685**	
ALL FIELDS			**4,671,265**

II. Obtaining the 22 Thomson Scientific Fields from the TvL Scheme

The 22 TS fields are obtained as follows from the 38 TvL disciplines and some sub-field rearrangement (sub-fields are in bold):

(I) CLINICAL MEDICINE = 28 + 29 + 32 + 33 + 34 + (**92 + 119 + 120 + 121 + 122 + 123 + 125**);

(II) BIOLOGY AND BIOCHEMISTRY = 19 + 22 + **24** + (**118** + **124**) – **92**;

(III) NEUROSCIENCES AND BEHAVIORAL SCIENCES = 30;

(IV) MOLECULAR BIOLOGY & GENETICS = 20;

(V) PSYCHIATRY AND PSYCHOLOGY = 31;

(VI) PHARMACOLOGY & TOXICOLOGY = 27;

(VII) MICROBIOLOGY = 21;

(VIII) IMMUNOLOGY = 26;

(IX) CHEMISTRY = 8 + 13;

10) PHYSICS = 11;

(XI) COMPUTER SCIENCE = 16;

(XII) MATHEMATICS AND STATISTICS = 14 + 15;

(XIII) SPACE SCIENCE = 12;

(XIV) ENGINEERING SCIENCES = 1 + 3 + 4 + 5+ 6 + 7 + 9 + 10 – **24**;

(XV) PLANT & ANIMAL SCIENCE = 24;

(XVI) MATERIALS SCIENCE = 2;

(XVII) GEOSCIENCES = 17;

(XVIII) ENVIRONMENTAL SCIENCES AND ECOLOGY = 18;

(XIX) AGRICULTURAL SCIENCES = 23;

(XX) MULTIDISCIPLINARY SCIENCES = 35;

(XXI) SOCIAL SCIENCES, GENERAL = 36;

(XXII) ECONOMICS AND BUSINESS = 37 + 38

Table A2. Distribution of Articles By Thomson Scientific Fields, 1998-2002.

		Number of Articles	%
LIFE SCIENCES			
I	Clinical Medicine	949,942	19.7
II	Biology & Biochemistry	403,055	8.4
III	Neuroscience & Behavioral Science	174,865	3.6
IV	Molecular Biology & Genetics	150,237	3.1
V	Psychiatry & Psychology	121,854	2.5
VI	Pharmacology & Toxicology	124,416	2.6
VII	Microbiology	86,780	1.8
VIII	Immunology	97,831	2.0
PHYSICAL SCIENCES			
IX	Chemistry	462,144	9.6
X	Physics	539,547	11.2
XI	Computer Science	94,657	2.0
XII	Mathematics	124,023	2.6
XIII	Space Science	59,843	1.2
OTHER NATURAL SCIENCES			
XIV	Engineering	374,409	7.8
XV	Plant & Animal Science	223,460	4.6
XVI	Materials Science	219,698	4.6
XVII	Geosciences	128,359	2.7
XVIII	Environment & Ecology	132,631	2.8
XIX	Agricultural Sciences	97,993	2.0
XX	Multidisciplinary	31,984	0.7
SOCIAL SCIENCES			
XXI	Social Sciences, General	154,562	3.2
XXII	Economics & Business	62,685	1.3
ALL TS FIELDS		**4,814,975**	**100.0**

III. A Map of Science Inspired in Glänzel and Schubert (2003)

It should be noted that a merit of Glänzel and Schubert (2003) is that papers –and not journals– are directly assigned to the different disciplines. In particular, papers published in the journals *Nature* and *Science*, which are included in the Multidisciplinary TS category, are individually assigned to the corresponding disciplines. Lacking information about individual papers, or even about journals, what we have attempted is simply an assignment of our TS sub-fields (excluding the Multidisciplinary sub-field 183) to GS disciplines.

The GS scheme consists of 64 disciplines and 14 fields (excluding the Arts and Humanities field that is not studied in this paper). However, we have been unable to find a clear correspondence between GS disciplines in the social sciences and our sub-fields in the two social sciences distinguished by TS, except for three exceptions: the subfields of Environmental Studies (included in the A3 GS discipline), Gerontology (M1), and Rehabilitation (M8). The remaining TS sub-fields within the Health Sciences (TvL discipline 33) and the Social Sciences (TvL disciplines 36 to 38) have been left out of our version of the GS scheme.

On the other hand, we have found useful to create a new GS discipline, namely, Pediatrics, labelled M10 in Clinical and Medicine II. Consequently, we are left with 61 disciplines in 12 fields corresponding exclusively to the natural sciences (plus the exceptions above mentioned). The correspondence with the 176 TS sub-fields in the natural sciences is as follows:

Table A3. Distribution of Articles By Disciplines and Fields, Glänzel and Schubert Scheme, 1998-2002

		Number of Articles		
		Sub-fields	Disciplines	FIELDS
		(1)	(2)	(3)
	i. AGRICULTURAL & ENVIRONMENT			**216,170**
A1	**Agricultural Sciences & Technology**		**42,585**	
	102 Agricultural Engineering	4,386		
	103 Agriculture, Multidisciplinary	14,772		
	104 Agronomy	23,691		
A2	**Plant & Animal Sciences & Technology**		**19,750**	
	85 Limnology	5,513		
	86 Soil Science	14,237		
A3	**Environment Science & Technology**		**82,436**	
	82 Biodiversity Conservation	6,528		
	84 Environmental Sciences	70,700		
	191. Environmental Studies	9,950		
A4	**Food & Animal Sciences & Technology**		**92,178**	
	105 Food Science & Technology	44,708		
	106 Nutrition & Dietetics	22,023		
	107 Agriculture, Dairy & Animal Science	21,730		
	111 Horticulture	10,080		
	ii. BIOLOGY			**357,768**
Z1	**Animal Sciences**		**57,250**	
	114 Ornithology	4,348		

	117 Zoology	33,580		
	108 Entomology	19,359		
Z2	**Aquatic Sciences**		**65,235**	
	87 Water Resources	25,750		
	109 Fisheries	15,539		
	112 Marine & Freshwater Biology	32,289		
Z3	**Microbiology**		**86,780**	
	96 Microbiology	56,148		
	97 Parasitology	10,815		
	98 Virology	20,557		
Z4	**Plant Sciences**		**79,538**	
	110 Forestry	11,061		
	113 Mycology	5,945		
	115 Plant Sciences	63,921		
Z5	**Pure and Applied Ecology**		**40,881**	
	83 Ecology	40,881		
Z6	**Veterinary Sciences**		**51,650**	
	116 Veterinary Sciences	51,650		
	iii. BIOSCIENCES			**370,134**
B0	**Multidisciplinary Biology**		**35,878**	
	99 Biology	24,484		
	100 Biology, Miscellaneous	423		
	101 Evolutionary Biology	10,971		
B1	**Biochemistry, Biophysics & Molecular Biology**		**248,022**	
	88 Biochemical Research Methods	33,589		
	89 Biochemistry & Molecular Biology	213,448		
	90 Biophysics	48,861		
B2	**Cell Biology**		**83,777**	
	93 Cell Biology	83,777		
B3	**Genetics & Development Biology**		**77,680**	
	94 Genetics & Heredity	62,866		
	95 Developmental Biology	16,822		
	v. BIOMEDICAL RESEARCH			**319,499**
R1	**Anatomy & Pathology**		**34,962**	
	123 Pathology	29,076		
	118 Anatomy & Morphology	6,114		
R2	**Biomaterials & Bioengineering**		**83,994**	
	120 Engineering, Biomedical	19,413		
	91 Biotechnology & Applied Microbiology	64,772		

R3	**Experimental & Laboratory Medicine**		**55,351**	
	121 Medical Laboratory Technology	10,317		
	122 Medicine, Research & Experimental	43,246		
	124 Microscopy	3,992		
R4	**Pharmacology & Toxicology**		**124,416**	
	128 Pharmacology & Pharmacy	101,509		
	129 Toxicology	30,778		
R5	**Physiology**		**43,378**	
	124 Physiology	43,378		
	v. CLINICAL MED. I (INTERNAL)			**459,991**
I1	**Cardiovascular & Respiratory Medicine**		**72,773**	
	131 Cardiac & Cardiovascular Systems	55,264		
	138 Respiratory System	28,392		
I2	**Endocrinology & Metabolism**		**48,723**	
	133 Endocrinology & Metabolism	48,723		
I3	**General & Internal Medicine**		**141,296**	
	140 Anesthesiology	16,884		
	141 Critical Care Medicine	13,246		
	132 Emergency Medicine	6,830		
	134 Gastroenterology & Hepatology	35,304		
	136 Medicine, General & Internal	65,120		
	139 Tropical Medicine	6,858		
I4	**Hematology & Oncology**		**115,938**	
	135 Hematology	41,982		
	137 Oncology	80,976		
I5	**Immunology**		**100,492**	
	130 Allergy	9,133		
	126 Immunology	81,689		
	127 Infectious Diseases	32,212		
	vi. CLINICAL MED. II (NON-INT).			**518,473**
M1	**Age & Gender Related Medicine**		**55,016**	
	143. Geriatrics & Gerontology	9,448		
	145. Obstetrics & Gynecology	32,587		
	119 Andrology	1,428		
	92 Reproductive Biology	16,676		
	196. Gerontology	6,962		
M2	**Dentistry**		**21,077**	
	173. Dentistry & Oral Surgery	21,077		
M3	**Dermatology & Urogenital System**		**55,202**	

	142. Dermatology	21,489		
	155. Urology & Nephrology	33,713		
M4	**Ophthalmology & Otolaryngology**		**43,788**	
	148. Otorhinolaryngology	17,583		
	146. Ophthalmology	26,205		
M5	**Paramedicine**		**2,511**	
	144. Integrative & Complementary Medicine	2,511		
M6	**Psychiatry & Neurology**		**101,744**	
	157. Clinical Neurology	67,356		
	162. Psychiatry	43,699		
M7	**Radiology & Nuclear Medicine**		**54,431**	
	125 Radiology, Nuclear Medicine & Medical Imaging	54,431		
M8	**Rheumatology & Orthopedics**		**61,870**	
	147. Orthopedics	24,353		
	151. Rheumatology	10,668		
	152. Sport Sciences	21,023		
	179. Rehabilitation	14,159		
M9	**Surgery**		**146,033**	
	153. Surgery	104,727		
	154. Transplantation	21,179		
	150. Peripheral Vascular Disease	36,793		
M10	**Pediatrics**		**42,958**	
	149. Pediatrics	42,958		
	vii. NEUROSCIENCES & BEHAVIOR			**209,740**
N1	**Neurosciences & Psychology**		**114,271**	
	158. Neuroimaging	6,294		
	159. Neurosciences	110,738		
N2	**Psychology & Behavioral Sciences**		**105,694**	
	156. Behavioral Sciences	14,569		
	160. Psychology, Biological	4,015		
	163. Psychology	16,239		
	164. Psychology, Applied	8,837		
	165. Psychology, Clinical	18,050		
	166. Psychology, Developmental	10,085		
	167. Psychology, Educational	5,376		
	168. Psychology, Experimental	15,701		
	169. Psychology, Mathematical	1,760		
	170. Psychology, Multidisciplinary	18,987		
	171. Psychology, Psychoanalysis	2,490		

	172. Psychology, Social	9,726		
	161. Social Sciences, Biomedical	6,365		
	viii. CHEMISTRY			**718,253**
C0	**Multidisciplinary Chemistry**		**101,864**	
	57 Chemistry, Multidisciplinary	101,864		
C1	**Analytical, Inorganic & Nuclear Chemistry**		**114,057**	
	55 Chemistry, Inorganic & Nuclear	48,939		
	53 Chemistry, Analytical	67,870		
C2	**Applied Chemistry & Chemical Engineering**		**95,945**	
	54 Chemistry, Applied	34,686		
	31 Engineering, Chemical	67,230		
C3	**Organic & Medicinal Chemistry**		**96,627**	
	56 Chemistry, Medicinal	24,515		
	58 Chemistry, Organic	77,870		
C4	**Physical Chemistry**		**145,810**	
	59 Chemistry, Physical	125,544		
	60 Electrochemistry	20,266		
C5	**Polymer Science**		**57,159**	
	61 Polymer Science	57,159		
C6	**Materials Science**		**225,937**	
	3 Materials Science, Biomaterials	6,570		
	4 Materials Science, Ceramics	20,067		
	5. Materials Science, Characterization & Testing	6,605		
	6 Materials Science, Coatings & Films	22,284		
	7 Materials Science, Composite	9,566		
	8 Materials Science, Multidisciplinary	137,363		
	9 Materials Science, Paper & Wood	7,273		
	10 Materials Science, Textiles	5,149		
	11 Metallurgy & Metallurgical Engineering	41,039		
	12 Nanoscience & Nanotechnology	19,199		
	ix. PHYSICS			**539,547**
P0	**Multidisciplinary Physics**		**113,631**	
	47 Physics, Multidisciplinary	83,795		
	50 Spectroscopy	29,836		
P1	**Applied Physics**		**212,467**	
	39 Acoustics	14,675		
	40 Crystallography	28,320		
	41 Optics	53,608		
	42 Physics, Applied	126,236		

P2	**Atomic, Molecular & Chemical Physics**		**60,889**	
	43 Physics, Atomic, Molecular & Chemical	60,889		
P3	**Classical Physics**		**17,689**	
	51 Thermodynamics	17,689		
P4	**Math.ematical & Theoretical Physics**		**33,785**	
	46 Physics, Mathematical	33,785		
P5	**Particle & Nuclear Physics**		**56,668**	
	48 Physics, Nuclear	25,345		
	49 Physics, Particles & Fields	39,308		
P6	**Physics of Solids, Fluids & Plasmas**		**131,006**	
	44 Physics, Condensed Matter	106,896		
	45 Physics, Fluids & Plasmas	24,110		
	x. GEOSIENCES & SPACE SCIENCES			**211,395**
G1	**Astronomy & Astrophysics**		**59,843**	
	52 Astronomy & Astrophysics	59,843		
G2	**Geoscscience & Technology**		**90,591**	
	73 Geochemistry & Geophysics	26,133		
	74 Geography, Physical	8,824		
	75 Geology	7,846		
	76 Geosciences, Multidisciplinary	46,211		
	25 Imaging Science & Photographic Technology	4,897		
	29 Engineering, Geological	4,650		
	80 Paleontology	6,629		
	81 Remote Sensing	5,027		
G3	**Hydrology & Oceanography**		**21,537**	
	79 Oceanography	19,217		
	35 Engineering, Ocean	3,470		
G4	**Meteorology, Atmospheric & Aerospace Science & Tech.**		**45,125**	
	77 Meteorology & Atmospheric Sciences	27,409		
	32 Engineering, Aerospace	20,377		
G5	**Mineralogy & Petrology**		**13,246**	
	78 Mineralogy	7,415		
	30 Mining & Mineral Processing	7,360		
	xi. ENGINEERING			**464,668**
E1	**Computer Science & Information Technology**		**120,147**	
	65 Computer Science, Artificial Intelligence	23,740		
	66 Computer Science, Cybernetics	4,694		
	67 Computer Science, Hardware & Architecture	13,256		
	68 Computer Science, Information Systems	21,158		

	69 Computer Science, Interdisciplinary Applications	27,529		
	70 Computer Science, Software Engineering	18,926		
	71 Computer Science, Theory & Methods	33,333		
	72 Mathematical & Computational Biology	7,409		
E2	**Electrical & Electronic Engineering**		**129,184**	
	1. Engineering, Electrical & Electronic	124,872		
	2 Telecommunications	23,341		
E3	**Energy & Fuels**		**68,928**	
	26 Energy & Fuels	30,104		
	27 Nuclear Science & Technology	36,780		
	28 Engineering, Petroleum	11,542		
E4	**General & Traditional Engineeering**		**215,897**	
	13 Construction & Building Technology	8,820		
	14 Engineering, Civil	23,153		
	15 Engineering, Environmental	21,097		
	16 Engineering, Marine	2,793		
	17 Transportation Science & Technology	6,022		
	18 Engineering, Industrial	14,160		
	19 Engineering, Manufacturing	14,497		
	20 Engineering, Mechanical	41,254		
	21 Mechanics	43,470		
	22 Robotics	3,208		
	23 Instruments & Instrumentation	40,354		
	33 Automation & Control Systems	17,335		
	34 Engineering, Multidisciplinary	22,817		
	36 Ergonomics	3,041		
	38 Operations Research & Management Science	18,629		
	xii. MATHEMATICS			**139,241**
H1	**Applied Mathematics**		**89,243**	
	63 Mathematics, Applied	53,017		
	64 Statistics & Probability	23,229		
	37 Mathematics, Interdisciplinary Applications	17,566		
H2	**Pure Mathematics**		**66,308**	
	62 Mathematics	66,308		
	ALL SUB-FIELDS			
	ALL DISCIPLINES		**5,073,141**	
	ALL FIELDS			**4,524,879**

Table B. Characteristics of Thomson Scientific Sub-fields

	REFERENCE DISTRIBUTION				CITATION DISTRIBUTION		
	Mean Reference Rate	*h*-index	Coefficient of Variation	References Made/ Citations Received	Mean Citation Rate	*h*-index	Coefficient of Variation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
i. ENGINEERING	**16.6**	**140**	**0.8**	**4.7**	**3.5**	**119**	**1.9**
1. Electrical Engineering	**14.4**	**96**	**0.8**	**4.4**	**3.3**	**85**	**2.0**
1. Engineering, Electrical & Electronic	14.4	96	0.8	4.3	3.3	85	2.0
2 Telecommunications	13.3	68	0.9	5.5	2.4	50	2.4
2. Materials Science	**17.3**	**107**	**0.8**	**4.1**	**4.2**	**107**	**1.9**
3 Materials Science, Biomaterials	28.4	72	0.5	3.0	9.4	53	1.2
4 Materials Science, Ceramics	15.8	76	0.8	4.8	3.3	37	1.6
5 Materials Science, Charact. & Testing	12.2	56	1.0	9.1	1.3	19	2.2
6 Materials Science, Coatings & Films	18.8	74	0.6	3.5	5.4	50	1.3
7 Materials Science, Composite	16.4	66	0.7	6.7	2.4	26	1.6
8 Materials Science, Multidisciplinary	18.1	99	0.7	3.8	4.7	104	1.9
9 Materials Science, Paper & Wood	12.2	55	1.0	7.4	1.6	18	1.7
10 Materials Science, Textiles	12.9	51	0.9	7.3	1.8	19	1.9
11 Metallurgy & Metallurgical Engineering	16.6	85	0.8	5.3	3.1	55	2.0
12 Nanoscience & Nanotechnology	17.4	75	0.7	3.0	5.8	70	1.8
3. Civil Engineering	**17.7**	**86**	**0.8**	**4.8**	**3.7**	**63**	**2.0**
13 Construction & Building Technology	15.6	60	0.7	7.0	2.2	21	1.4
14 Engineering, Civil	16.4	75	0.8	7.7	2.1	33	1.7
15 Engineering, Environmental	21.3	82	0.7	3.5	6.1	63	1.7
16 Engineering, Marine	2.7	33	2.9	16.7	0.2	8	5.2
17 Transportation Science & Technology	14.8	55	0.7	10.1	1.5	21	2.0
4. Mechanical Engineering	**17.5**	**95**	**0.8**	**6.2**	**2.8**	**52**	**1.6**
18 Engineering, Industrial	16.5	80	0.9	8.3	2.0	23	1.6
19 Engineering, Manufacturing	15.9	70	0.8	7.3	2.2	23	1.4
20 Engineering, Mechanical	15.9	84	0.8	6.2	2.6	40	1.7
21 Mechanics	19.9	87	0.7	5.5	3.6	48	1.5
22 Robotics	18.4	57	0.8	8.1	2.3	20	1.6
5. Instruments	**15.7**	**93**	**0.9**	**4.1**	**3.8**	**60**	**1.7**
23 Instruments & Instrumentation	13.6	81	0.8	4.0	3.4	51	1.7
24 Microscopy	28.8	87	0.8	4.7	6.2	39	1.2
25 Imaging Science & Photographic Techn(	22.0	66	0.7	4.3	5.1	43	1.8

6. Fuels and Energy	**14.3**	**95**	**1.0**	**5.0**	**2.9**	**58**	**1.8**
26 Energy & Fuels	14.1	87	1.1	5.1	2.8	48	2.0
27 Nuclear Science & Technology	14.6	86	0.8	4.7	3.1	47	1.7
28 Engineering, Petroleum	8.6	76	1.6	13.3	0.6	17	3.0
7. Geological Engineering	**17.6**	**75**	**0.8**	**7.0**	**2.5**	**32**	**1.8**
29 Engineering, Geological	22.5	65	0.6	8.7	2.6	20	1.4
30 Mining & Mineral Processing	14.9	69	1.0	6.0	2.5	30	2.0
8. Chemical Engineering	**17.3**	**93**	**0.8**	**4.6**	**3.7**	**60**	**1.7**
31 Engineering, Chemical	17.3	93	0.8	4.6	3.7	60	1.7
9. Aerospace Engineering	**8.8**	**66**	**1.4**	**8.8**	**1.0**	**20**	**2.4**
32 Engineering, Aerospace	8.8	66	1.4	8.8	1.0	20	2.4
10. Other Engineering	**19.5**	**95**	**0.7**	**6.8**	**2.9**	**57**	**1.7**
33 Automation & Control Systems	16.8	69	0.8	6.4	2.6	39	1.9
34 Engineering, Multidisciplinary	16.3	79	0.8	6.8	2.4	39	2.0
35 Engineering, Ocean	16.6	53	0.8	6.4	2.6	26	1.9
36 Ergonomics	28.2	71	0.6	8.7	3.3	22	1.2
37 Mathematics, Interdisciplinary Applicatio	23.6	85	0.6	5.8	4.1	46	1.5
38 Operations Research & Management Sci	21.5	83	0.7	7.9	2.7	32	1.5
ii. PHYSICS AND ASTRONOMY	**22.0**	**152**	**0.7**	**3.2**	**6.9**	**218**	**2.2**
11 Physics	**21.2**	**146**	**0.7**	**3.3**	**6.5**	**204**	**2.3**
39 Acoustics	20.0	74	0.6	5.1	3.9	38	1.4
40 Crystallography	17.2	82	0.7	4.1	4.2	64	6.1
41 Optics	17.8	88	0.7	3.4	5.2	76	1.7
42 Physics, Applied	16.4	95	0.7	2.9	5.7	114	1.8
43 Physics, Atomic, Molecular & Chemical	30.3	97	0.6	3.6	8.5	93	1.3
44 Physics, Condensed Matter	20.6	99	0.7	3.7	5.5	97	1.7
45 Physics, Fluids & Plasmas	25.6	87	0.6	3.6	7.0	65	1.3
46 Physics, Mathematical	23.9	89	0.6	4.2	5.7	71	1.6
47 Physics, Multidisciplinary	20.5	102	0.7	2.5	8.2	162	2.5
48 Physics, Nuclear	23.2	96	0.8	4.6	5.0	63	1.8
49 Physics, Particles & Fields	26.7	100	0.7	3.0	9.0	133	2.7
50 Spectroscopy	21.0	89	0.7	3.7	5.6	63	1.5
51 Thermodynamics	19.0	79	0.7	5.7	3.3	34	1.4
12. Space Science	**31.7**	**99**	**0.6**	**2.8**	**11.3**	**150**	**1.7**
52 Astronomy & Astrophysics	31.7	99	0.6	2.8	11.3	150	1.7
iii. CHEMISTRY	**24.4**	**136**	**0.7**	**3.3**	**7.4**	**156**	**1.5**
13. Chemistry	**24.4**	**136**	**0.7**	**3.3**	**7.4**	**156**	**1.5**
53 Chemistry, Analytical	21.6	97	0.7	3.0	7.3	91	1.5
54 Chemistry, Applied	21.6	88	0.7	4.1	5.3	61	1.4

55 Chemistry, Inorganic & Nuclear	28.6	98	0.6	4.4	6.6	69	1.3
56 Chemistry, Medicinal	23.6	88	0.6	3.2	7.3	67	1.3
57 Chemistry, Multidisciplinary	22.9	100	0.8	2.8	8.3	135	1.8
58 Chemistry, Organic	26.2	97	0.6	3.3	7.9	88	1.2
59 Chemistry, Physical	27.2	101	0.6	3.5	7.7	109	1.4
60 Electrochemistry	22.0	77	0.6	3.0	7.3	61	1.2
61 Polymer Science	22.1	90	0.7	3.7	6.0	85	1.5
iv. MATHEMATICS	**17.3**	**98**	**0.7**	**6.5**	**2.7**	**78**	**4.0**
14. Mathematics	**16.7**	**96**	**0.7**	**7.4**	**2.3**	**48**	**1.7**
62 Mathematics	15.5	90	0.7	8.1	1.9	36	1.7
63 Mathematics, Applied	17.8	89	0.7	6.8	2.6	45	1.7
15. Statistics	**19.7**	**80**	**0.6**	**4.4**	**4.5**	**75**	**5.2**
64 Statistics & Probability	19.7	80	0.6	4.4	4.5	75	5.2
v. COMPUTER SCIENCE	**20.5**	**100**	**0.7**	**6.2**	**3.3**	**98**	**3.6**
16. Computer Science	**20.5**	**100**	**0.7**	**6.2**	**3.3**	**98**	**3.6**
65 Computer Science, Artificial Intelligence	23.3	89	0.7	6.1	3.8	62	2.1
66 Computer Science, Cybernetics	23.9	78	0.7	9.9	2.4	27	1.9
67 Computer Science, Hardware & Architec	17.8	74	0.8	6.1	2.9	47	2.4
68 Computer Science, Information Systems	21.0	89	0.8	6.4	3.3	56	2.4
69 Computer Science, Interdisciplinary App	20.9	86	0.7	4.7	4.5	80	4.9
70 Computer Science, Software Engineering	18.5	83	0.8	7.5	2.5	40	1.9
71 Computer Science, Theory & Methods	18.8	86	0.7	8.1	2.3	51	2.3
72 Mathematical & Computational Biology	25.5	81	0.6	3.0	8.4	73	4.7
vi. EARTH & ENVIRONMENT	**31.5**	**163**	**0.7**	**4.9**	**6.4**	**107**	**1.5**
17. Geosciences	**33.1**	**146**	**0.7**	**5.2**	**6.4**	**93**	**1.5**
73 Geochemistry & Geophysics	36.2	105	0.6	5.1	7.1	63	1.5
74 Geography, Physical	40.3	99	0.6	6.3	6.4	44	1.2
75 Geology	38.7	96	0.6	6.8	5.7	42	1.3
76 Geosciences, Multidisciplinary	30.3	119	0.7	5.9	5.1	62	1.5
77 Meteorology & Atmospheric Sciences	29.4	96	0.6	3.8	7.7	78	1.5
78 Mineralogy	32.7	91	0.7	6.3	5.2	40	1.4
79 Oceanography	36.2	99	0.6	5.0	7.2	55	1.2
80 Paleontology	44.7	98	0.6	9.6	4.6	35	1.4
81 Remote Sensing	23.6	67	0.6	4.4	5.3	38	1.6
18. Environment Sciences & Ecology	**30.3**	**126**	**0.7**	**4.7**	**6.5**	**91**	**1.4**
82 Biodiversity Conservation	34.2	89	0.6	5.7	6.0	46	1.5
83 Ecology	38.7	100	0.6	4.7	8.2	76	1.2
84 Environmental Sciences	27.7	112	0.7	4.4	6.3	81	1.5
85 Limnology	35.0	84	0.5	5.1	6.9	42	1.2

86 Soil Science	27.8	88	0.6	6.0	4.7	38	1.3
87 Water Resources	22.4	90	0.7	5.3	4.2	45	1.3
vii. BIOLOGY & BIOCHEMISTRY	**33.4**	**161**	**0.5**	**2.5**	**13.5**	**290**	**1.8**
19. Basic Life Sciences	**33.2**	**142**	**0.5**	**2.4**	**13.9**	**267**	**1.8**
88 Biochemical Research Methods	23.7	91	0.6	2.6	9.2	99	3.3
89 Biochemistry & Molecular Biology	36.1	124	0.5	2.2	16.3	259	1.7
90 Biophysics	31.2	95	0.5	2.9	10.9	107	1.8
91 Biotechnology & Applied Microbiology	26.2	98	0.6	3.0	8.7	130	2.3
92 Reproductive Biology	33.2	100	0.6	3.5	9.5	66	1.1
20. Molecular Biology & Genetics	**36.6**	**120**	**0.5**	**2.0**	**18.2**	**266**	**1.7**
93 Cell Biology	39.1	104	0.5	1.8	21.3	252	1.6
94 Genetics & Heredity	32.9	99	0.6	2.1	15.5	193	1.7
95 Developmental Biology	41.9	96	0.5	2.2	19.3	144	1.5
21. Microbiology	**31.2**	**110**	**0.5**	**2.8**	**11.1**	**122**	**1.3**
96 Microbiology	29.7	99	0.6	2.8	10.7	107	1.3
97 Parasitology	26.6	91	0.6	4.5	6.0	45	1.3
98 Virology	37.6	93	0.5	2.6	14.6	98	1.1
viii. AGRICULTURE & FOOD SCIEN(	**27.8**	**170**	**0.7**	**5.4**	**5.2**	**108**	**1.6**
22. Biology	**35.4**	**106**	**0.6**	**4.0**	**8.9**	**93**	**1.4**
99 Biology	32.2	100	0.6	4.3	7.4	78	1.5
100 Biology, Miscellaneous	25.1	43	0.6	7.5	3.4	15	1.4
101 Evolutionary Biology	42.9	98	0.5	3.4	12.5	79	1.2
23. Agricultural Sciences	**24.9**	**130**	**0.7**	**4.8**	**5.2**	**82**	**1.6**
102 Agricultural Engineering	20.2	57	0.6	6.2	3.3	23	1.3
103 Agriculture, Multidisciplinary	24.9	81	0.6	5.3	4.7	49	1.6
104 Agronomy	24.0	92	0.7	5.8	4.1	45	1.5
105 Food Science & Technology	22.6	96	0.7	4.6	4.9	58	1.4
106 Nutrition & Dietetics	31.0	114	0.6	3.8	8.1	78	1.5
24. Plant and Animal Sciences	**29.0**	**162**	**0.7**	**5.6**	**5.1**	**102**	**1.5**
107 Agriculture, Dairy & Animal Science	24.6	93	0.6	6.7	3.7	40	1.5
108 Entomology	25.5	91	0.6	6.7	3.8	36	1.3
109 Fisheries	29.3	96	0.6	5.8	5.1	38	1.1
110 Forestry	32.8	94	0.6	6.4	5.1	42	1.3
111 Horticulture	24.3	70	0.6	5.5	4.4	39	1.4
112 Marine & Freshwater Biology	36.0	116	0.6	6.0	6.0	49	1.1
113 Mycology	26.8	80	0.6	5.4	5.0	37	1.8
114 Ornithology	31.1	74	0.5	7.6	4.1	28	2.0
115 Plant Sciences	31.0	109	0.6	4.3	7.2	95	1.6
116 Veterinary Sciences	21.8	97	0.7	6.3	3.5	54	1.6

117 Zoology	35.4	116	0.6	6.6	5.4	58	1.4
ix. BIOMEDICAL SCIENCES	**28.9**	**159**	**0.6**	**3.0**	**9.7**	**224**	**1.7**
25. Biomedical	**28.3**	**133**	**0.6**	**3.0**	**9.4**	**197**	**1.8**
118 Anatomy & Morphology	35.8	92	0.6	6.4	5.6	40	1.3
119 Andrology	29.7	62	0.6	5.4	5.5	26	1.2
120 Engineering, Biomedical	24.4	84	0.6	3.6	6.7	59	1.3
121 Medical Laboratory Technology	24.1	91	0.7	4.1	5.9	54	1.6
122 Medicine, Research & Experimental	29.8	102	0.6	2.3	13.3	192	2.2
123 Pathology	28.5	97	0.6	3.3	8.8	92	1.5
124 Physiology	36.0	101	0.5	3.5	10.4	80	1.1
125 Radiology, Nuclear Medicine & Medica	21.9	96	0.7	2.9	7.6	100	1.6
26. Immunology	**30.1**	**109**	**0.6**	**2.3**	**13.2**	**190**	**1.6**
126 Immunology	31.4	101	0.6	2.2	14.0	189	1.6
127 Infectious Diseases	27.3	97	0.6	2.4	11.6	102	1.3
27. Pharmacology & Toxicology	**28.8**	**137**	**0.6**	**3.7**	**7.7**	**108**	**1.4**
128 Pharmacology & Pharmacy	28.2	127	0.6	3.6	7.9	105	1.4
129 Toxicology	32.2	107	0.6	4.5	7.1	67	1.3
x. CLINICAL MEDICINE	**28.2**	**194**	**0.7**	**3.1**	**9.2**	**313**	**2.1**
28. General & Internal Medicine	**28.0**	**149**	**0.6**	**2.3**	**12.0**	**304**	**2.3**
130 Allergy	24.6	85	0.7	2.9	8.4	65	1.5
131 Cardiac & Cardiovascular Systems	24.5	98	0.6	2.1	11.4	160	1.8
132 Emergency Medicine	20.3	81	0.8	5.0	4.1	38	1.6
133 Endocrinology & Metabolism	34.7	106	0.5	2.7	12.7	129	1.4
134 Gastroenterology & Hepatology	28.7	100	0.6	2.8	10.4	119	1.6
135 Hematology	31.3	100	0.6	1.9	16.5	170	1.5
136 Medicine, General & Internal	21.3	99	0.8	1.8	12.1	272	4.1
137 Oncology	31.3	101	0.5	2.3	13.9	165	1.7
138 Respiratory System	25.1	98	0.7	2.5	10.0	90	1.3
139 Tropical Medicine	21.4	72	0.7	4.3	4.9	34	1.3
29. Non-internal Medicine	**24.1**	**151**	**0.7**	**3.1**	**7.7**	**176**	**1.7**
140. Anesthesiology	22.9	86	0.7	3.4	6.7	61	1.4
141. Critical Care Medicine	27.3	88	0.6	2.6	10.6	81	1.4
142. Dermatology	21.7	92	0.7	3.7	5.8	59	1.4
143. Geriatrics & Gerontology	32.5	95	0.6	4.1	7.8	53	1.3
144. Integrative & Complementary Medicin	23.0	67	0.7	5.5	4.2	24	1.2
145. Obstetrics & Gynecology	23.2	99	0.7	3.5	6.6	66	1.4
146. Ophthalmology	24.1	91	0.7	3.5	6.9	73	1.5
147. Orthopedics	23.8	93	0.7	4.2	5.6	58	1.4
148. Otorhinolaryngology	21.1	89	0.7	5.0	4.2	38	1.3

149. Pediatrics	22.3	96	0.7	4.0	5.6	77	1.6
150. Peripheral Vascular Disease	29.8	97	0.5	1.9	15.4	158	1.6
151. Rheumatology	28.4	85	0.6	2.7	10.6	79	1.5
152. Sport Sciences	27.4	94	0.6	4.8	5.7	50	1.3
153. Surgery	20.6	99	0.7	3.3	6.3	96	1.5
154. Transplantation	18.9	81	0.8	2.8	6.7	71	1.6
155. Urology & Nephrology	25.1	97	0.7	2.8	9.1	97	1.6
30. Neurosiences & Behavior	**34.6**	**153**	**0.6**	**3.1**	**11.2**	**161**	**1.4**
156. Behavioral Sciences	39.9	98	0.5	4.6	8.7	58	1.0
157. Clinical Neurology	28.5	119	0.7	3.1	9.2	116	1.5
158. Neuroimaging	26.4	83	0.7	2.6	10.2	70	1.6
159. Neurosciences	37.9	141	0.6	2.9	12.9	157	1.4
160. Psychology, Biological	37.8	85	0.5	5.2	7.3	41	1.2
161. Social Sciences, Biomedical	31.6	89	0.7	6.2	5.1	41	1.5
31. Psychiatry And Psychology	**34.3**	**145**	**0.6**	**4.9**	**6.9**	**115**	**1.6**
162. Psychiatry	32.4	119	0.6	3.4	9.5	107	1.5
163. Psychology	36.9	98	0.6	4.8	7.7	61	1.2
164. Psychology, Applied	33.9	94	0.7	8.0	4.2	34	1.3
165. Psychology, Clinical	34.7	99	0.6	4.8	7.2	65	1.4
166. Psychology, Developmental	40.3	98	0.5	5.3	7.6	55	1.3
167. Psychology, Educational	39.0	91	0.6	7.8	5.0	41	1.5
168. Psychology, Experimental	36.1	98	0.6	4.9	7.4	63	1.4
169. Psychology, Mathematical	28.8	67	0.6	5.7	5.1	31	1.4
170. Psychology, Multidisciplinary	32.6	100	0.7	7.0	4.7	62	2.0
171. Psychology, Psychoanalysis	28.6	80	0.8	11.5	2.5	22	1.8
172. Psychology, Social	41.8	97	0.5	6.9	6.0	50	1.4
32. Dentistry	**25.6**	**90**	**0.6**	**5.0**	**5.1**	**46**	**1.2**
173. Dentistry & Oral Surgery	25.6	90	0.6	5.0	5.1	46	1.2
33. Health Sciences	**27.0**	**120**	**0.7**	**4.7**	**5.8**	**86**	**1.5**
174. Health Care Sciences & Services	23.0	91	0.8	4.1	5.6	55	1.5
175. Health Policy & Services	25.7	88	0.8	4.4	5.8	54	1.6
176. Medicine, Legal	20.1	76	0.9	4.9	4.1	32	1.4
177. Nursing	28.0	84	0.7	9.6	2.9	27	1.3
178. Public, Environmental & Occupational	27.1	104	0.7	3.9	6.9	82	1.4
179. Rehabilitation	29.1	94	0.7	7.2	4.1	36	1.4
180. Substance Abuse	34.4	93	0.6	4.7	7.4	47	1.1
34. Other Clinical Medicine	**17.3**	**78**	**0.8**	**5.1**	**3.4**	**42**	**1.8**
181. Education, Scientific Disciplines	14.2	66	0.9	5.0	2.8	29	1.6
182. Medical Informatics	21.2	72	0.7	5.2	4.1	40	1.9

xi. MULTIDISCIPLINARY	**17.0**	**103**	**1.1**	**5.1**	**3.4**	**75**	**2.6**
35. Multidisciplinary	**17.0**	**103**	**1.1**	**5.1**	**3.4**	**75**	**2.6**
183. Multidisciplinary Sciences	17.0	103	1.1	5.1	3.4	75	2.6
xii. SOCIAL SCIENCES	**29.2**	**178**	**0.8**	**9.9**	**2.9**	**76**	**1.9**
36. General	**31.4**	**173**	**0.8**	**11.1**	**2.8**	**63**	**1.8**
184. Anthropology	39.0	99	0.7	14.3	2.7	28	1.6
185. Area Studies	38.2	94	0.7	31.8	1.2	13	1.7
186. Communication	34.9	91	0.7	12.4	2.8	25	1.5
187. Criminology & Penology	34.2	89	0.8	11.4	3.0	24	1.6
188. Demography	30.7	79	0.7	7.9	3.9	24	1.8
189. Education & Educational Research	27.9	94	0.8	12.9	2.2	28	1.9
190. Education, Special	33.9	86	0.7	9.6	3.5	24	1.3
191. Environmental Studies	33.7	96	0.7	9.8	3.4	30	1.3
192. Ethics	25.7	82	0.8	12.4	2.1	18	1.6
193. Ethnic Studies	34.6	73	0.7	20.4	1.7	12	2.1
194. Family Studies	34.2	86	0.6	8.3	4.1	29	1.5
195. Geography	41.5	97	0.6	10.0	4.1	34	1.5
196. Gerontology	32.6	89	0.6	4.6	7.0	48	1.4
197. History Of Social Sciences	44.8	91	0.7	34.4	1.3	9	1.4
198. Information Science & Library Science	17.4	88	1.1	7.4	2.4	39	2.2
199. International Relations	25.7	98	1.1	13.0	2.0	30	2.2
200. Law	34.1	142	1.0	12.7	2.7	35	1.8
201. Linguistics	37.5	94	0.6	10.0	3.8	32	1.5
202. Medical Ethics	19.5	53	0.9	5.5	3.6	18	1.4
203. Planning & Development	33.8	92	0.7	12.3	2.7	28	1.7
204. Political Science	25.0	98	1.0	13.9	1.8	33	2.3
205. Public Administration	32.9	85	0.7	14.0	2.3	21	1.5
206. Social Issues	22.4	86	1.0	10.6	2.1	26	1.9
207. Social Sciences, Interdisciplinary	30.8	92	0.7	13.3	2.3	28	1.7
208. Social Work	35.4	88	0.6	13.2	2.7	21	1.3
209. Sociology	38.4	106	0.7	13.5	2.9	35	1.9
210. Transportation	23.0	58	0.6	6.8	3.4	20	1.2
211. Urban Studies	34.7	91	0.7	11.4	3.1	26	1.5
212. Women's Studies	33.3	85	0.6	12.6	2.6	26	1.6
37. Economics	**26.1**	**100**	**0.7**	**7.8**	**3.3**	**56**	**1.8**
213. Agricultural Economics & Policy	24.8	54	0.5	9.7	2.5	16	1.3
214. Economics	26.0	99	0.7	7.7	3.4	56	1.8
215. Industrial Relations & Labor	29.2	78	0.8	9.8	3.0	21	1.5
216. Social Sciences, Mathematical Methods	24.8	74	0.7	6.3	4.0	37	1.7

38. Business & Management	**24.0**	**101**	**1.1**	**7.6**	**3.1**	**55**	**2.0**
217. Business	26.6	96	1.0	7.4	3.6	46	1.9
218. Business, Finance	13.4	83	1.5	5.7	2.4	45	2.6
219. Management	34.4	99	0.7	7.9	4.4	49	1.7

Table C1. Disciplines and Fields Characteristics, Tijssen and van Leeuwen Scheme

	Mean Citation Rate	***h*-index**	**Coefficient of Variation**
	(1)	**(2)**	**(3)**
(i) ENGINEERING SCIENCES	3.5	119	1.9
1. Electrical Engineering	3.3	85	2.0
2. Materials Science	4.2	107	1.9
3. Civil Engineering	3.7	63	2.0
4. Mechanical Engineering	2.8	52	1.6
5. Instruments & Instrumentation	3.8	60	1.7
6. Fuels And Energy	2.9	58	1.8
7. Geological Engineering	2.5	32	1.8
8. Chemical Engineering	3.7	60	1.7
9. Aerospace Engineering	1.0	20	2.4
10. Other Engineering Sciences	2.9	57	1.7
(ii) PHYSICS & ASTRONOMY	6.9	218	2.2
11. Physics	6.5	204	2.3
12. Space Science	11.3	150	1.7
(iii) CHEMISTRY	7.4	156	1.5
13. Chemistry	7.4	156	1.5
(iv) MATHEMATICS & STATISTICS	2.7	78	4.0
14. Mathematics	2.3	48	1.7
15. Statistics	4.5	75	5.2
(v) COMPUTER SCIENCE	3.3	98	3.6
16. Computer Science	3.3	98	3.6
(vi) EARTH & ENVIRONMENTAL SC.	6.4	107	1.5
17. Geosciences	6.4	93	1.5
18. Environmental Sciences & Ecology	6.5	91	1.4
(vii) BIOLOGY & BIOCHEMISTRY	13.5	290	1.8
19. Basic Life Sciences	13.9	267	1.8
20. Molecular Biology & Genetics	18.2	266	1.7
21. Microbiology	11.1	122	1.3
(viii) AGRICULTURAL. & FOOD SCS.	5.2	108	1.6
22. Biology	8.9	93	1.4
23. Agricultural Sciences	5.2	82	1.6
24. Plant & Animal Science	5.1	102	1.5
(ix) BIOMEDICAL SCIENCES	9.7	224	1.7

25. Biomedical Sciences	9.4	197	1.8
26. Immunology	13.2	190	1.6
27. Pharmacology & Toxicology	7.7	108	1.4
(x) CLINICAL MEDICINE	9.2	313	2.1
28. General And Internal Medicine	12.0	304	2.3
29. Non-Internal Medicine Specialties	7.7	176	1.7
30. Neurosciences And Behavioral Sciences	11.2	161	1.4
31. Psychiatry And Psychology	6.9	115	1.6
32. Dentistry	5.1	46	1.2
33. Health Sciences	5.8	86	1.5
34. Other Clinical Medicine	3.4	42	1.8
(xi) MULTIDISCIPLINARY SCIENCES	3.4	75	2.6
35. Multidisciplinary Sciences	3.4	75	2.6
(xii) SOCIAL SCIENCES	2.9	76	1.9
36. Social Sciences, General	2.8	63	1.8
37. Economics	3.3	56	1.8
38. Business And Management	3.1	55	2.0

Table C2. Thomson Scientific Fields Characteristics

		Mean Citation Rate (1)	*h*-index (2)	Coefficient of Variation (3)
LIFE SCIENCES				
I	**Clinical Medicine**	8.2	309	2.3
II	**Biology & Biochemistry**	12.2	267	1.9
III	**Neuroscience & Behavioral Science**	11.2	161	1.4
IV	**Molecular Biology & Genetics**	18.2	266	1.7
V	**Psychiatry & Psychology**	6.9	115	1.6
VI	**Pharmacology & Toxicology**	7.7	108	1.4
VII	**Microbiology**	11.1	122	1.3
VIII	**Immunology**	13.2	190	1.6
PHYSICAL SCIENCES				
IX	**Chemistry**	6.9	151	1.6
X	**Physics**	6.5	204	2.3
XI	**Computer Science**	3.7	97	3.6
XII	**Mathematics**	2.7	78	4
XIII	**Space Science**	11.3	150	1.7
OTHER NATURAL SCIENCES				
XIV	**Engineering**	3.0	93	1.9
XV	**Plant & Animal Science**	5.1	102	1.6
XVI	**Material Science**	4.3	107	1.9
XVII	**Geosciences**	6.4	93	1.5
XVIII	**Environment & Ecology**	6.5	91	1.4
XIX	**Agricultural Sciences**	5.2	82	1.6
XX	**Multidisciplinary**	3.4	75	2.6
SOCIAL SCIENCES				
XXI	**Social Sciences, General**	2.8	63	1.8
XXII	**Economics & Business**	3.3	64	1.9

Table C3. Disciplines and Fields Characteristics, Glänzel and Schubert Scheme

		Mean Citation Rate (1)	*h*-index (2)	Coefficient of Variation (3)
	i. AGRICULTURAL AND ENVIRON.	5.3	95	1.5
A1	**Agricultural Science & Technology**	4.2	57	1.5
A2	**Plant & Animal Science & Technology**	5.3	46	1.3
A3	**Environmental Science & Technology**	5.9	81	1.5
A4	**Food & Animal Science & Technology**	5.3	81	1.5
	ii. BIOLOGY	6.8	136	1.5
Z1	**Animal Sciences**	4.8	60	1.4
Z2	**Aquatic Sciences**	5.1	53	1.2
Z3	**Microbiology**	11.1	122	1.3
Z4	**Plant Sciences**	6.7	96	1.6
Z5	**Pure and Applied Ecology**	8.2	76	1.2
Z6	**Veterinary Sciences**	3.5	54	1.6
	iii. BIOSCIENCES	14.6	284	1.8
B0	**Multidiscipl. Biology**	8.9	93	1.4
B1	**Biochemistry, BioPhysics & Mol. Bio.**	15.3	262	1.8
B2	**Cell Biology**	21.3	252	1.6
B3	**Genetics & Development Biology**	15.4	194	1.6
	iv. BIOMEDICAL RESEARCH.	8.9	212	1.9
R1	**Anatomy & Pathology**	8.2	93	1.6
R2	**Biomaterials & Bioengineering**	8.3	131	2.2
R3	**Experimental/Lab. Med.**	11.7	193	2.3
R4	**Pharmacology & Toxicology**	7.7	108	1.4
R5	**Physiology**	10.4	80	1.1
	v. CLINICAL MED. I (INTERNAL)	12.1	321	2.2
I1	**Cardiovascular & Respiratory Medicine**	11.4	162	1.7
I2	**Endocrinology & Metabolism**	12.7	129	1.4
I3	**General & Internal Medicine**	10.3	274	3.4
I4	**Hematology & Oncology**	15.1	201	1.6
I5	**Immunology**	12.9	190	1.6
	vi. CLINICAL MED. II (NON-INT).	7.8	187	1.7
M1	**Age & Gender Related Medicine**	7.1	78	1.3
M2	**Dentistry**	5.1	46	1.2
M3	**Dermatology & Urogenital System**	7.8	98	1.6

M4	**Ophthalmology & Otolaryngology**	5.8	73	1.5
M5	**Paramedicine**	4.2	24	1.2
M6	**Psychiatry & Neurology**	9.5	131	1.5
M7	**Radiology & Nuclear Medicine**	7.6	100	1.6
M8	**Rheumatology & Orthopedics**	6.2	85	1.6
M9	**Surgery**	8.6	163	1.8
M10	**Pediatrics**	5.6	77	1.6
	vii. NEUROSCIENCES & BEHAV.	9.6	159	1.5
N1	**Neurosciences & Psychopharmacology**	12.8	157	1.4
N2	**Psychology & Behavioral Sciences**	6.2	90	1.5
	viii. CHEMISTRY	6.1	159	1.6
C0	**Multidisciplinary Chemistry**	8.3	135	1.8
C1	**Analytical, Inorganic & Nuclear Chem.**	7.1	97	1.4
C2	**Applied Chemistry & Chem. Engineering**	4.2	68	1.6
C3	**Organic & Medicinal Chemistry**	7.8	93	1.3
C4	**Physical Chemistry**	7.7	110	1.4
C5	**Polymer Science**	6.0	85	1.5
C6	**Materials Science**	4.2	107	1.9
	ix. PHYSICS	6.5	204	2.3
P0	**Multidisciplinary Physics**	7.5	163	2.4
P1	**Applied Physics**	5.3	123	2.4
P2	**Atom., Mol. & Chemical Physics**	8.5	93	1.3
P3	**Classical Physics**	3.3	34	1.4
P4	**Mathematics & Theoretical Physics**	5.7	71	1.6
P5	**Particle & Nuclear Physics**	8.0	135	2.6
P6	**Physics of Solids, Fluids & Plasmas**	5.8	100	1.6
	x. GEOSIENCES & SPACE SCIENCES	7.2	157	1.8
G1	**Astronomy & Astrophysics**	11.3	150	1.7
G2	**Geosciences & Technology**	5.7	76	1.5
G3	**Hydrology & Oceanography**	6.8	55	1.3
G4	**Meteo./Atmos. & Aerosp. Sci. & Tech.**	5.0	78	1.9
G5	**Mineralogy & Petrology**	4.0	43	1.6
	xi. ENGINEERING	3.2	113	2.5
E1	**Computer Scinece & Information Tech.**	3.3	98	3.6
E2	**Electrical & Electronic Engineering**	3.3	85	2.0
E3	**Energy & Fuels**	2.9	58	1.8
E4	**General & Traditional Engineering**	3.2	77	1.8
	xii. MATHEMATICS	2.8	80	3.7
H1	**Applied Mathematics**	3.3	80	3.8

H2	**Pure Mathematics**	1.9	36	1.7

Table D1. Characteristic Scores and Scales For Thomson Scientific Sub-fields

	Uncited Articles	Poorly Cited	Fairly Cited	Remarkably Cited	Outstandingly Cited	Total	S_2	S_3*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i. ENGINEERING	35.2	34.9	20.5	6.6	2.8	100.0	9.7	3.0
1. Electrical Engineering	36.4	35.9	19.4	5.8	2.5	100.0	9.6	2.9
1 Engineering, Electrical & Electronic	35.9	36.0	19.6	5.9	2.6	100.0	9.6	3.0
2 Telecommunications	49.9	24.5	18.7	4.8	2.1	100.0	8.2	3.1
2. Materials Science	30.5	41.4	19.2	6.4	2.5	100.0	11.9	2.9
3 Materials Science, Biomaterials	7.2	58.2	22.7	8.1	3.9	100.0	19.8	3.0
4 Materials Science, Ceramics	37.5	32.6	20.5	6.4	3.0	100.0	9.1	2.8
5 Mats. Science, Characterization & Testing	57.5	16.5	17.7	5.6	2.6	100.0	4.5	2.7
6 Materials Science, Coatings & Films	18.4	48.4	22.6	7.0	3.6	100.0	12.3	3.0
7 Materials Science, Composite	36.2	31.9	22.1	6.9	2.9	100.0	6.3	2.9
8 Materials Science, Multidisciplinary	26.6	42.7	22.0	6.2	2.6	100.0	12.3	3.2
9 Materials Science, Paper & Wood	50.2	17.0	21.4	7.3	4.2	100.0	4.5	2.7
10 Materials Science, Textiles	45.7	20.1	22.8	8.2	3.2	100.0	4.6	3.0
11 Metallurgy & Metallurgical Engineering	39.5	33.4	19.0	5.6	2.5	100.0	9.4	2.8
12 Nanoscience & Nanotechnology	19.8	49.0	22.2	6.5	2.5	100.0	14.5	3.2
3. Civil Engineering	35.9	34.0	21.0	6.4	2.8	100.0	10.3	3.0
13 Construction & Building Technology	35.4	34.0	19.4	7.8	3.5	100.0	5.7	2.6
14 Engineering, Civil	43.8	28.5	19.2	5.8	2.6	100.0	6.3	2.7
15 Engineering, Environmental	21.8	49.1	20.1	6.0	3.0	100.0	16.1	2.9
16 Engineering, Marine	93.0	0.0	5.1	1.3	0.5	100.0	2.3	2.2
17 Transportation Science & Technology	56.9	16.3	16.8	6.8	3.3	100.0	4.9	2.5
4. Mechanical Engineering	34.4	30.8	22.4	8.1	4.3	100.0	6.9	2.9
18 Engineering, Industrial	41.6	19.3	25.6	9.6	4.0	100.0	4.6	3.1
19 Engineering, Manufacturing	36.8	33.1	18.8	6.9	4.4	100.0	5.7	2.5
20 Engineering, Mechanical	36.2	31.4	21.8	7.2	3.4	100.0	6.5	2.9
21 Mechanics	26.2	40.2	22.2	7.3	4.0	100.0	8.7	3.0
22 Robotics	38.9	32.4	19.8	6.1	2.8	100.0	6.3	2.8
5. Instruments	31.8	34.3	23.3	7.3	3.4	100.0	9.5	3.1
23 Instruments & Instrumentation	34.3	34.6	20.3	7.3	3.5	100.0	9.0	2.8
24 Microscopy	14.6	53.2	22.4	6.7	3.1	100.0	14.1	3.1
25 Imaging Science & Photographic Tech.	28.6	43.4	19.7	5.8	2.5	100.0	14.4	3.0
6. Fuels and Energy	39.0	27.1	23.5	7.0	3.4	100.0	7.3	3.1
26 Energy & Fuels	45.6	23.1	20.8	7.4	3.2	100.0	7.8	2.8
27 Nuclear Science & Technology	30.9	40.6	19.9	6.1	2.5	100.0	8.3	2.9
28 Engineering, Petroleum	78.6	0.0	15.8	3.8	1.9	100.0	3.0	2.3
7. Geological Engineering	39.5	29.0	21.5	7.1	2.9	100.0	6.7	2.9
29 Engineering, Geological	28.3	35.4	23.2	9.3	3.8	100.0	5.8	2.9
30 Mining & Mineral Processing	45.9	25.1	20.7	5.6	2.7	100.0	7.3	3.0
8. Chemical Engineering	34.5	32.6	22.1	7.5	3.3	100.0	9.6	3.0
31 Engineering, Chemical	34.5	32.6	22.1	7.5	3.3	100.0	9.6	3.0

9. Aerospace	68.0	0.0	22.9	5.8	3.3	100.0	3.1	2.2
32 Engineering, Aerospace	68.0	0.0	22.9	5.8	3.3	100.0	3.1	2.2
10. Other Engineering	35.8	30.0	24.4	6.6	3.2	100.0	7.1	3.2
33 Automation & Control Systems	41.5	27.1	22.7	6.2	2.5	100.0	7.1	3.1
34 Engineering, Multidisciplinary	45.0	27.4	19.3	5.6	2.8	100.0	7.3	2.9
35 Engineering, Ocean	39.7	29.8	21.6	6.3	2.5	100.0	7.2	3.1
36 Ergonomics	22.6	45.0	21.5	7.3	3.6	100.0	7.5	2.9
37 Mathematics, Interdisciplinary Applications	23.3	47.9	19.7	5.9	3.1	100.0	10.6	2.9
38 Operations Research & Management Scien	31.0	33.8	24.1	7.6	3.5	100.0	6.4	3.1
ii. PHYSICS AND ASTRONOMY	**20.5**	**49.1**	**21.2**	**6.6**	**2.6**	**100.0**	**18.0**	**3.2**
11 Physics	20.7	50.3	20.6	6.0	2.4	100.0	17.5	3.2
39 Acoustics	22.9	40.4	24.2	7.9	4.6	100.0	8.7	3.1
40 Crystallography	26.9	46.7	20.5	5.0	1.0	100.0	12.1	3.6
41 Optics	23.8	46.7	19.9	6.5	3.0	100.0	13.7	2.9
42 Physics, Applied	21.0	48.6	21.3	6.4	2.8	100.0	14.6	3.1
43 Physics, Atomic, Molecular & Chemical	9.1	57.0	23.0	7.5	3.3	100.0	18.4	3.1
44 Physics, Condensed Matter	22.5	46.7	21.7	6.3	2.8	100.0	14.1	3.1
45 Physics, Fluids & Plasmas	11.4	57.1	21.6	6.8	3.1	100.0	16.1	3.0
46 Physics, Mathematical	18.9	48.5	22.5	7.1	3.0	100.0	13.5	3.1
47 Physics, Multidisciplinary	26.5	49.4	17.2	4.9	2.0	100.0	27.2	3.0
48 Physics, Nuclear	25.4	47.5	19.1	5.6	2.5	100.0	14.1	2.9
49 Physics, Particles & Fields	20.2	52.3	20.0	5.4	2.1	100.0	26.2	3.3
50 Spectroscopy	17.7	49.0	23.1	6.8	3.3	100.0	13.2	3.1
51 Thermodynamics	23.2	44.4	21.1	7.6	3.7	100.0	7.8	2.8
12. Space Science	15.8	54.0	21.2	6.4	2.7	100.0	28.6	3.1
52 Astronomy & Astrophysics	15.8	54.0	21.2	6.4	2.7	100.0	28.6	3.1
iii. CHEMISTRY	**16.7**	**52.0**	**21.1**	**7.0**	**3.2**	**100.0**	**17.9**	**3.0**
13. Chemistry	16.7	52.0	21.1	7.0	3.2	100.0	17.9	3.0
53 Chemistry, Analytical	13.9	54.2	22.2	6.7	3.0	100.0	17.2	3.1
54 Chemistry, Applied	22.1	44.7	22.4	7.1	3.7	100.0	12.4	3.0
55 Chemistry, Inorganic & Nuclear	15.9	49.2	23.2	8.0	3.7	100.0	14.6	3.0
56 Chemistry, Medicinal	9.8	57.2	22.8	6.9	3.3	100.0	16.2	3.1
57 Chemistry, Multidisciplinary	23.3	49.5	18.3	6.0	2.8	100.0	24.6	2.8
58 Chemistry, Organic	10.2	52.5	25.5	7.9	3.9	100.0	16.1	3.3
59 Chemistry, Physical	13.4	52.8	23.2	7.2	3.4	100.0	17.5	3.2
60 Electrochemistry	14.3	51.5	23.2	7.5	3.4	100.0	16.2	3.1
61 Polymer Science	19.4	46.1	23.2	7.7	3.5	100.0	13.9	3.1
iv. MATHEMATICS	**37.0**	**32.4**	**22.5**	**6.0**	**2.0**	**100.0**	**7.3**	**3.4**
14. Mathematics	38.9	32.6	19.8	5.8	2.8	100.0	6.4	2.8
62 Mathematics	41.6	20.9	25.2	8.5	3.7	100.0	4.5	3.2
63 Mathematics, Applied	35.6	32.5	21.2	7.6	3.1	100.0	6.8	2.9

15. Statistics	28.7	46.4	19.5	4.3	1.1	100.0	14.1	3.8
64 Statistics & Probability	28.7	46.4	19.5	4.3	1.1	100.0	14.1	3.8
v. COMPUTER SCIENCE	**37.7**	**36.4**	**19.0**	**5.0**	**1.8**	**100.0**	**10.3**	**3.2**
16. Computer Science	37.7	36.4	19.0	5.0	1.8	100.0	10.3	3.2
65 Computer Science, Artificial Intelligence	33.9	36.0	21.4	6.1	2.6	100.0	10.6	3.2
66 Computer Science, Cybernetics	45.1	26.2	20.4	5.5	2.8	100.0	7.1	2.9
67 Computer Science, Hardware & Architectu	40.4	29.2	22.1	6.2	2.2	100.0	8.3	3.3
68 Computer Science, Information Systems	39.3	36.5	17.0	5.0	2.2	100.0	10.9	2.9
69 Computer Science, Interdisciplinary Applic	29.8	44.9	18.8	5.1	1.4	100.0	14.0	3.4
70 Computer Science, Software Engineering	42.5	29.2	19.9	5.9	2.5	100.0	7.3	2.9
71 Computer Science, Theory & Methods	45.0	28.7	18.9	5.3	2.0	100.0	7.4	3.0
72 Mathematical & Computational Biology	12.6	62.9	19.7	3.7	1.0	100.0	25.3	4.3
vi. EARTH & ENVIRON.	**17.1**	**50.3**	**21.4**	**7.8**	**3.4**	**100.0**	**15.0**	**2.9**
17 Geosciences	17.4	49.7	21.7	7.8	3.5	100.0	15.0	2.9
73 Geochemistry & Geophysics	15.3	52.3	21.7	7.3	3.5	100.0	16.5	2.9
74 Geography, Physical	13.4	51.7	23.3	7.9	3.8	100.0	13.7	3.1
75 Geology	18.6	46.4	22.5	8.3	4.1	100.0	12.7	2.9
76 Geosciences, Multidisciplinary	21.9	47.3	20.7	6.8	3.3	100.0	12.6	2.9
77 Meteorology & Atmospheric Sciences	14.5	52.3	22.2	7.6	3.4	100.0	18.0	3.0
78 Mineralogy	19.6	49.0	21.2	6.7	3.5	100.0	12.4	2.9
79 Oceanography	15.0	50.2	22.5	8.1	4.2	100.0	15.7	2.9
80 Paleontology	20.8	44.8	23.0	7.8	3.6	100.0	10.7	3.0
81 Remote Sensing	19.5	48.6	21.3	7.5	3.0	100.0	12.8	3.0
18. Environmental Sciences & Ecology	16.0	50.9	21.7	7.7	3.7	100.0	14.9	2.9
82 Biodiversity Conservation	22.1	43.4	23.6	7.7	3.2	100.0	14.1	3.1
83 Ecology	12.4	53.9	21.8	8.0	3.8	100.0	17.9	2.9
84 Environmental Sciences	15.4	52.6	21.3	7.5	3.3	100.0	14.9	3.0
85 Limnology	12.2	51.8	23.3	8.2	4.5	100.0	14.7	3.1
86 Soil Science	21.7	41.8	24.6	8.0	3.9	100.0	10.2	3.1
87 Water Resources	21.5	46.2	20.7	7.5	4.2	100.0	9.9	2.8
vii. BIOLOGY & BIOCHEMISTRY	**8.9**	**61.2**	**21.1**	**6.1**	**2.7**	**100.0**	**33.5**	**3.2**
19. Basic Life Sciences	8.7	60.2	21.9	6.5	2.8	100.0	33.7	3.2
88 Biochemical Research Methods	8.3	62.3	21.9	5.9	1.6	100.0	22.2	3.5
89 Biochemistry & Molecular Biology	6.6	63.2	21.3	6.3	2.6	100.0	39.6	3.2
90 Biophysics	8.2	58.3	22.8	7.4	3.3	100.0	24.0	3.2
91 Biotechnology & Applied Microbiology	15.8	53.6	21.6	6.5	2.5	100.0	21.9	3.2
92 Reproductive Biology	7.9	57.1	23.0	8.1	4.0	100.0	19.7	3.1
20. Molecular Biology & Genetics	7.1	64.8	19.6	5.8	2.7	100.0	47.8	3.1
93 Cell Biology	5.7	65.7	19.7	6.1	2.8	100.0	55.8	3.0
94 Genetics & Heredity	9.0	61.9	20.7	5.8	2.6	100.0	39.6	3.2
95 Developmental Biology	5.1	65.5	20.2	6.2	3.0	100.0	48.0	3.0

21. Microbiology	8.0	59.7	21.6	7.3	3.4	100.0	24.8	3.0
96 Microbiology	8.7	56.7	23.7	7.4	3.5	100.0	23.1	3.2
97 Parasitology	12.6	50.4	24.9	8.3	3.8	100.0	12.5	3.2
98 Virology	3.9	61.6	23.3	7.5	3.7	100.0	30.3	3.2
viii. AGRICULTURAL & FOOD SCS.	**21.5**	**48.3**	**20.2**	**7.0**	**3.1**	**100.0**	**13.0**	**2.9**
22. Biology	14.8	51.1	22.8	7.7	3.6	100.0	20.7	3.0
99 Biology	18.8	50.4	20.4	6.8	3.6	100.0	19.0	2.9
100 Biology, Miscellaneous	27.0	40.9	21.3	6.6	4.3	100.0	8.2	2.9
101 Evolutionary Biology	5.5	59.4	23.9	7.9	3.3	100.0	25.7	3.2
23. Agricultural Sciences	21.9	47.6	21.3	6.2	3.0	100.0	13.1	3.0
102 Agricultural Engineering	22.3	44.6	22.2	7.6	3.3	100.0	7.5	2.9
103 Agriculture, Multidisciplinary	28.5	38.3	22.5	7.2	3.5	100.0	11.6	3.0
104 Agronomy	24.4	45.7	20.3	6.5	3.0	100.0	10.5	2.9
105 Food Science & Technology	21.2	42.4	23.9	8.2	4.4	100.0	10.8	3.1
106 Nutrition & Dietetics	15.0	54.4	21.6	6.1	3.0	100.0	20.0	3.1
24. Plant and Animal Science	21.0	48.8	20.3	6.9	3.0	100.0	12.9	2.9
107 Agriculture, Dairy & Animal Science	29.3	37.2	23.1	7.0	3.3	100.0	9.0	3.0
108 Entomology	23.9	39.2	24.9	8.2	3.8	100.0	8.4	3.1
109 Fisheries	14.8	51.7	20.8	8.4	4.4	100.0	10.9	2.8
110 Forestry	16.5	51.7	21.0	7.7	3.1	100.0	11.7	2.9
111 Horticulture	21.3	47.6	20.3	7.1	3.8	100.0	10.9	2.9
112 Marine & Freshwater Biology	11.3	48.7	26.0	9.4	4.6	100.0	11.5	3.3
113 Mycology	21.3	43.8	23.4	8.3	3.2	100.0	11.6	3.1
114 Ornithology	19.1	50.4	20.7	7.0	2.8	100.0	9.8	2.9
115 Plant Sciences	14.7	56.0	20.5	5.8	2.9	100.0	18.2	3.1
116 Veterinary Sciences	33.1	35.8	21.6	6.4	3.1	100.0	9.1	2.9
117 Zoology	16.8	50.1	22.5	7.0	3.6	100.0	12.3	3.0
ix. BIOMEDICAL SCIENCES	**12.4**	**56.7**	**21.6**	**6.5**	**2.8**	**100.0**	**23.8**	**3.2**
25. Biomedical	14.1	56.7	21.0	5.8	2.3	100.0	24.4	3.2
118 Anatomy & Morphology	16.5	49.2	23.2	7.5	3.6	100.0	12.6	3.1
119 Andrology	12.6	54.6	21.8	7.1	3.8	100.0	12.2	3.0
120 Engineering, Biomedical	14.1	51.9	23.1	7.2	3.7	100.0	15.1	3.1
121 Medical Laboratory Technology	19.0	47.7	23.1	6.8	3.3	100.0	14.2	3.2
122 Medicine, Research & Experimental	17.2	59.3	16.9	4.6	2.1	100.0	44.0	3.1
123 Pathology	14.2	54.2	21.5	6.7	3.3	100.0	21.5	3.0
124 Physiology	8.2	56.3	23.4	8.0	4.1	100.0	21.3	3.1
125 Radiology, Nuclear Med. & Med. Imaging	15.4	53.3	21.3	6.7	3.2	100.0	18.7	3.0
26. Immunology	9.3	61.3	20.9	6.0	2.5	100.0	33.1	3.2
126 Immunology	8.5	60.4	22.1	6.2	2.7	100.0	34.0	3.3
127 Infectious Diseases	9.3	56.8	22.9	7.5	3.5	100.0	25.6	3.1
27. Pharmacology & Toxicology	11.9	54.6	23.0	7.1	3.5	100.0	17.5	3.2

128 Pharmacology & Pharmacy	11.9	53.9	23.0	7.6	3.5	100.0	17.8	3.2
129 Toxicology	11.2	57.0	22.1	6.5	3.2	100.0	16.1	3.1
X CLINICAL MEDICINE	**15.8**	**55.9**	**20.1**	**6.0**	**2.3**	**100.0**	**24.8**	**3.1**
28. General & Internal Medicine	14.5	58.2	19.8	5.5	2.0	100.0	33.5	3.2
130 Allergy	15.9	52.5	21.3	7.1	3.3	100.0	20.7	2.9
131 Cardiac & Cardiovascular Systems	15.0	57.2	19.3	5.9	2.6	100.0	31.8	3.0
132 Emergency Medicine	23.6	47.3	20.2	5.9	3.0	100.0	10.6	2.9
133 Endocrinology & Metabolism	6.9	59.2	23.2	7.6	3.1	100.0	27.8	3.2
134 Gastroenterology & Hepatology	12.5	58.0	20.5	6.3	2.7	100.0	26.5	3.1
135 Hematology	8.4	61.6	20.5	6.5	3.0	100.0	41.4	3.0
136 Medicine, General & Internal	31.0	51.8	12.9	3.2	1.2	100.0	58.7	3.3
137 Oncology	7.8	60.3	22.3	6.7	2.9	100.0	32.5	3.2
138 Respiratory System	10.9	57.4	21.5	6.9	3.4	100.0	23.4	3.0
139 Tropical Medicine	18.8	44.5	23.5	9.1	4.1	100.0	10.7	3.0
29. Non-internal	16.5	52.4	21.8	6.4	2.8	100.0	19.2	3.1
140. Anaesthesiology	16.9	49.8	21.9	7.4	3.9	100.0	15.7	3.0
141. Critical Care Medicine	12.3	54.8	22.0	7.4	3.6	100.0	24.9	3.0
142. Dermatology	18.1	48.7	22.1	7.5	3.7	100.0	13.7	3.0
143. Geriatrics & Gerontology	14.9	49.8	23.9	7.6	3.9	100.0	17.3	3.1
144. Integrative & Complementary Medicine	19.9	46.9	22.2	7.5	3.5	100.0	9.4	2.9
145. Obstetrics & Gynaecology	16.4	50.4	22.5	7.2	3.6	100.0	15.3	3.0
146. Ophthalmology	15.4	51.0	23.3	7.2	3.1	100.0	16.1	3.2
147. Orthopedics	17.9	48.6	23.4	6.8	3.3	100.0	13.1	3.2
148. Otorhinolaryngology	20.3	47.2	20.7	7.6	4.2	100.0	9.9	2.8
149. Pediatrics	20.4	48.1	22.3	6.4	2.8	100.0	14.0	3.2
150. Peripheral Vascular Disease	10.0	59.8	20.8	6.5	2.9	100.0	38.7	3.0
151. Rheumatology	11.5	55.8	22.5	7.2	3.1	100.0	24.7	3.1
152. Sport Sciences	20.0	44.5	22.9	8.6	4.0	100.0	12.8	3.0
153. Surgery	18.1	51.7	20.3	6.8	3.0	100.0	15.9	2.9
154. Transplantation	18.2	50.0	21.9	6.9	3.1	100.0	16.6	3.1
155. Urology & Nephrology	15.4	54.5	20.6	6.6	3.0	100.0	22.7	2.9
30. Neurosciences & Behavior	10.7	58.8	21.3	6.2	3.0	100.0	27.0	3.1
156. Behavioral Sciences	5.1	57.7	24.5	8.6	4.1	100.0	16.8	3.3
157. Clinical Neurology	14.0	56.1	20.8	6.2	3.0	100.0	23.0	3.0
158. Neuroimaging	18.4	52.0	20.0	6.4	3.2	100.0	26.8	2.9
159. Neurosciences	8.9	58.2	22.7	6.8	3.4	100.0	29.5	3.2
160. Psychology, Biological	7.5	59.6	22.8	7.0	3.1	100.0	15.5	3.2
161. Social Sciences, Biomedical	17.7	52.7	20.3	6.4	2.8	100.0	12.6	3.0
31. Psychiatry & Psychology	18.6	49.0	22.7	6.7	3.0	100.0	17.1	3.2
162. Psychiatry	15.3	53.6	21.2	6.6	3.3	100.0	23.5	3.0
163. Psychology	12.4	52.4	23.4	7.9	3.8	100.0	16.5	3.1

164. Psychology, Applied	23.4	44.9	21.5	6.6	3.5	100.0	10.2	2.9
165. Psychology, Clinical	13.2	55.4	21.4	6.9	3.1	100.0	17.3	3.0
166. Psychology, Developmental	11.3	55.4	23.0	7.1	3.3	100.0	17.0	3.1
167. Psychology, Educational	22.3	48.9	19.3	6.3	3.2	100.0	13.3	2.8
168. Psychology, Experimental	14.2	53.9	21.8	6.7	3.3	100.0	17.4	3.0
169. Psychology, Mathematical	20.0	50.8	19.7	6.1	3.4	100.0	12.9	2.9
170. Psychology, Multidisciplinary	28.3	42.9	20.7	5.7	2.4	100.0	13.1	3.2
171. Psychology, Psychoanalysis	41.3	29.0	20.9	5.8	3.0	100.0	7.1	3.0
172. Psychology, Social	15.2	55.5	19.8	6.4	3.0	100.0	15.1	2.9
32. Dentistry	15.6	52.7	20.7	7.7	3.4	100.0	11.8	2.9
173. Dentistry & Oral Surgery	15.6	52.7	20.7	7.7	3.4	100.0	11.8	2.9
33. Health Sciences	18.4	47.9	22.9	7.5	3.3	100.0	13.5	3.1
174. Health Care Sciences & Services	19.0	47.9	23.0	7.1	3.0	100.0	13.2	3.1
175. Health Policy & Services	20.8	46.0	22.6	7.4	3.2	100.0	13.8	3.1
176. Medicine, Legal	21.7	47.9	21.5	6.3	2.6	100.0	10.1	3.0
177. Nursing	27.5	32.6	28.0	7.7	4.2	100.0	6.1	3.4
178. Public, Environ. & Occupational Health	15.1	50.7	23.0	7.6	3.6	100.0	15.8	3.1
179. Rehabilitation	23.4	46.2	21.0	6.3	3.0	100.0	10.0	2.9
180. Substance Abuse	9.5	55.9	22.8	7.8	4.1	100.0	15.6	3.0
34. Other Clinical Medicine	30.5	40.1	21.0	5.8	2.5	100.0	9.1	3.1
181. Education, Scientific Disciplines	32.6	33.7	21.9	7.9	3.9	100.0	6.9	3.0
182. Medical Informatics	27.9	44.2	20.0	5.8	2.1	100.0	11.2	3.0
xi. MULTIDISCIPLINARY	**45.6**	**30.9**	**17.1**	**4.5**	**1.9**	**100.0**	**12.2**	**3.1**
35. Multidisciplinary	45.6	30.9	17.1	4.5	1.9	100.0	12.2	3.1
183. Multidisciplinary Sciences	45.6	30.9	17.1	4.5	1.9	100.0	12.2	3.1
xii. SOCIAL SCIENCES	**38.2**	**28.9**	**22.4**	**7.2**	**3.5**	**100.0**	**7.7**	**3.1**
36. General	37.0	30.2	22.9	7.0	3.0	100.0	7.4	3.1
184. Anthropology	35.8	31.5	20.7	7.6	4.4	100.0	7.0	2.8
185. Area Studies	49.8	23.6	17.3	6.7	2.6	100.0	3.6	2.5
186. Communication	30.1	32.9	25.5	7.6	3.9	100.0	6.4	3.2
187. Criminology & Penology	38.2	34.6	17.4	6.0	3.7	100.0	8.8	2.5
188. Demography	27.2	38.6	23.8	7.3	3.1	100.0	9.3	3.3
189. Education & Educational Research	39.6	32.7	19.6	5.6	2.4	100.0	6.2	2.9
190. Education, Special	23.1	43.3	23.1	6.8	3.7	100.0	8.2	3.1
191. Environmental Studies	22.6	44.0	21.4	8.1	4.0	100.0	7.9	2.9
192. Ethics	39.1	32.9	17.9	6.7	3.4	100.0	5.8	2.6
193. Ethnic Studies	48.0	21.6	20.6	7.1	2.7	100.0	4.9	3.0
194. Family Studies	21.2	48.9	20.3	6.5	3.0	100.0	10.2	2.9
195. Geography	21.6	48.3	21.4	6.2	2.5	100.0	10.2	3.1
196. Gerontology	16.7	51.6	20.7	6.9	4.0	100.0	16.9	2.8
197. History Of Social Sciences	44.3	24.2	21.2	6.6	3.7	100.0	3.4	2.7

198. Information Science & Library Science	48.5	26.0	17.6	5.6	2.3	100.0	7.9	2.8
199. International Relations	50.2	18.3	22.1	6.8	2.6	100.0	5.7	3.2
200. Law	38.2	31.7	20.6	6.5	3.0	100.0	7.5	3.0
201. Linguistics	28.4	38.3	22.6	7.2	3.5	100.0	9.2	3.0
202. Medical Ethics	23.6	42.4	22.7	7.5	3.8	100.0	8.2	3.0
203. Planning & Development	34.0	33.1	21.5	7.7	3.7	100.0	6.9	3.0
204. Political Science	54.3	16.0	20.7	6.3	2.7	100.0	5.5	3.0
205. Public Administration	36.0	34.0	20.5	6.0	3.6	100.0	6.3	2.8
206. Social Issues	45.5	28.7	17.3	6.2	2.4	100.0	6.7	2.6
207. Social Sciences, Interdisciplinary	38.8	32.9	18.9	6.1	3.3	100.0	6.6	2.8
208. Social Work	28.9	35.0	25.6	6.4	4.0	100.0	6.1	3.2
209. Sociology	38.2	28.8	23.0	7.0	3.0	100.0	7.4	3.1
210. Transportation	22.2	42.8	22.2	7.5	5.4	100.0	7.6	2.9
211. Urban Studies	26.2	45.2	18.6	7.0	3.0	100.0	7.9	2.7
212. Women's Studies	35.2	31.3	22.7	7.3	3.5	100.0	6.6	3.0
37. Economics	31.4	40.2	20.2	5.7	2.5	100.0	9.3	3.1
213. Agricultural Economics & Policy	29.7	34.8	22.3	9.3	3.8	100.0	5.8	2.8
214. Economics	31.4	40.4	20.1	5.7	2.5	100.0	9.4	3.0
215. Industrial Relations & Labor	33.3	29.3	23.2	10.7	3.6	100.0	6.8	2.9
216. Social Sciences, Mathematical Methods	28.2	38.2	22.9	7.3	3.3	100.0	9.7	3.2
38. Business & Management	46.0	28.8	17.5	5.3	2.5	100.0	10.4	2.8
217. Business	42.6	28.8	19.3	6.2	3.1	100.0	10.7	2.8
218. Business, Finance	63.0	14.8	15.2	4.6	2.4	100.0	9.7	2.7
219. Management	27.5	43.9	20.0	5.7	2.9	100.0	12.0	3.0

Table D2. Characteristic Scores and Scales For the Thomson Scientific Fields

		Uncited Articles (1)	Poorly Cited (2)	Fairly Cited (3)	Remark. Cited (4)	Outs. Cited (5)	Total (6)	S_2 (7)	S_3* (8)
LIFE SCIENCES									
I	**Clinical Medicine**	18.8	53.7	19.6	5.7	2.2	100.0	22.8	3.1
II	**Biology & Biochemistry**	11.7	59.1	20.7	6.0	2.4	100.0	31.3	3.1
III	**Neuroscience & Behavioral Sci.**	10.7	58.8	21.3	6.2	3.0	100.0	27.0	3.1
IV	**Molecular Biology & Genetics**	7.1	64.8	19.6	5.8	2.7	100.0	47.8	3.1
V	**Psychiatry & Psychology**	18.6	49.0	22.7	6.7	3.0	100.0	17.1	3.2
VI	**Pharmacology & Toxicology**	11.9	54.6	23.0	7.1	3.5	100.0	17.5	3.2
VII	**Microbiology**	8.0	59.7	21.6	7.3	3.4	100.0	24.8	3.0
VIII	**Immunology**	9.3	61.3	20.9	6.0	2.5	100.0	33.1	3.2
PHYSICAL SCIENCES									
IX	**Chemistry**	19.1	47.6	22.9	7.2	3.2	100.0	16.5	3.1
X	**Physics**	20.7	50.3	20.6	6.0	2.4	100.0	17.5	3.2
XI	**Computer Science**	34.9	36.9	20.5	5.7	2.1	100.0	10.7	3.3
XII	**Mathematics**	37.0	32.4	22.5	6.0	2.0	100.0	7.3	3.4
XIII	**Space Science**	15.8	54.0	21.2	6.4	2.7	100.0	28.6	3.1
OTHER NATURAL SCIENCES									
XIV	**Engineering**	38.0	27.8	23.5	7.4	3.3	100.0	7.6	3.2
XV	**Plant & Animal Science**	21.9	48.8	20.8	6.0	2.5	100.0	13.0	3.0
XVI	**Material Science**	29.7	41.6	19.5	6.5	2.6	100.0	11.9	2.9
XVII	**Geosciences**	17.4	49.7	21.7	7.8	3.5	100.0	15.0	2.9
XVIII	**Environment & Ecology**	16.0	50.9	21.7	7.7	3.7	100.0	14.9	2.9
XIX	**Agricultural Sciences**	21.9	47.6	21.3	6.2	3.0	100.0	13.1	3.0
XX	**Multidisciplinary**	45.6	30.9	17.1	4.5	1.9	100.0	12.2	3.1
SOCIAL SCIENCES									
XXI	**Social Sciences, General**	37.0	30.2	22.9	7.0	3.0	100.0	7.4	3.1
XXII	**Economics & Business**	36.9	35.6	18.8	5.9	2.8	100.0	9.9	2.9

Table D3. Characteristic Scores and Scales For the Glänzel and Schubert Scheme

		Uncited Articles (1)	Poorly Cited (2)	Fairly Cited (3)	Remark. Cited (4)	Outstand. Cited (5)	Total (6)	S_2 (7)	S_3* (8)
	i. AGRIC. AND ENVIRONMENT	**20.9**	**48.2**	**21.7**	**6.4**	**2.9**	**100.0**	**13.0**	**3.0**
A1	**Agricultural Science & Technology**	25.7	43.8	20.5	6.8	3.3	100.0	10.7	2.8
	102. Agricultural Engineering	22.3	44.6	22.2	7.6	3.3	100.0	7.5	2.9
	103. Agriculture, Multidisciplinary	28.5	38.3	22.5	7.2	3.5	100.0	11.6	3.0
	104. Agronomy	24.4	45.7	20.3	6.5	3.0	100.0	10.5	2.9
A2	**Plant & Animal Sciences & Technology**	19.1	47.5	22.7	7.2	3.5	100.0	12.1	3.0
	85. Limnology	12.2	51.8	23.3	8.2	4.5	100.0	14.7	3.1
	86. Soil Science	21.7	41.8	24.6	8.0	3.9	100.0	10.2	3.1
A3	**Environmental Science &Technology**	17.0	48.4	23.7	7.4	3.5	100.0	13.4	3.2
	82. Biodiversity Conservation	22.1	43.4	23.6	7.7	3.2	100.0	14.1	3.1
	84. Environmental Sciences	15.4	52.6	21.3	7.5	3.3	100.0	14.9	3.0
	191. Environmental Studies	22.6	44.0	21.4	8.1	4.0	100.0	7.9	2.9
A4	**Food & Animal Science & Technology**	21.8	47.2	21.5	6.4	3.1	100.0	13.2	3.0
	105. Food Science & Technology	21.2	42.4	23.9	8.2	4.4	100.0	10.8	3.1
	106. Nutrition & Dietetics	15.0	54.4	21.6	6.1	3.0	100.0	20.0	3.1
	107. Agriculture, Dairy & Animal Science	29.3	37.2	23.1	7.0	3.3	100.0	9.0	3.0
	111. Horticulture	21.3	47.6	20.3	7.1	3.8	100.0	10.9	2.9
	ii. BIOLOGY	**17.0**	**49.7**	**23.2**	**6.9**	**3.2**	**100.0**	**16.1**	**3.2**
Z1	**Animal Sciences**	19.3	45.2	23.7	7.7	4.0	100.0	10.6	3.1
	114. Ornithology	19.1	50.4	20.7	7.0	2.8	100.0	9.8	2.9
	117. Zoology	16.8	50.1	22.5	7.0	3.6	100.0	12.3	3.0
	108. Entomology	23.9	39.2	24.9	8.2	3.8	100.0	8.4	3.1
Z2	**Aquatic Sciences**	16.4	50.8	21.9	7.4	3.5	100.0	11.3	2.9
	87. Water Resources	21.5	46.2	20.7	7.5	4.2	100.0	9.9	2.8
	109. Fisheries	14.8	51.7	20.8	8.4	4.4	100.0	10.9	2.8
	112. Marine & Freshwater Biology	11.3	48.7	26.0	9.4	4.6	100.0	11.5	3.3
Z3	**Microbiology**	8.0	59.7	21.6	7.3	3.4	100.0	24.8	3.0
	96. Microbiology	8.7	56.7	23.7	7.4	3.5	100.0	23.1	3.2
	97. Parasitology	12.6	50.4	24.9	8.3	3.8	100.0	12.5	3.2
	98. Virology	3.9	61.6	23.3	7.5	3.7	100.0	30.3	3.2
Z4	**Plant Sciences**	15.6	52.6	22.4	6.4	3.0	100.0	16.2	3.2
	110. Forestry	16.5	51.7	21.0	7.7	3.1	100.0	11.7	2.9
	113. Mycology	21.3	43.8	23.4	8.3	3.2	100.0	11.6	3.1
	115. Plant Sciences	14.7	56.0	20.5	5.8	2.9	100.0	18.2	3.1
Z5	**Pure and Applied Ecology**	12.4	53.9	21.8	8.0	3.8	100.0	17.9	2.9

Z6	**Veterinary Sciences**	33.1	35.8	21.6	6.4	3.1	100.0	9.1	2.9
	iii. BIOSCIENCES	**8.2**	**61.7**	**21.3**	**6.1**	**2.6**	**100.0**	**36.3**	**3.2**
B0	**Multidisciplinary Biology**	14.8	51.1	22.8	7.7	3.6	100.0	20.7	3.0
	99. Biology	18.8	50.4	20.4	6.8	3.6	100.0	19.0	2.9
	100. Biology, Miscellaneous	27.0	40.9	21.3	6.6	4.3	100.0	8.2	2.9
	101. Evolutionary Biology	5.5	59.4	23.9	7.9	3.3	100.0	25.7	3.2
B1	**Biochemistry, Biophysics & Molec. Bio.**	6.9	63.0	21.2	6.2	2.6	100.0	37.5	3.2
	88. Biochemical Research Methods	8.3	62.3	21.9	5.9	1.6	100.0	22.2	3.5
	89. Biochemistry & Molecular Biology	6.6	63.2	21.3	6.3	2.6	100.0	39.6	3.2
	90. Biophysics	8.2	58.3	22.8	7.4	3.3	100.0	24.0	3.2
B2	**Cell Biology**	5.7	65.7	19.7	6.1	2.8	100.0	55.8	3.0
B3	**Genetics & Development Biology**	8.3	62.2	20.6	6.1	2.7	100.0	38.6	3.1
	94. Genetics & Heredity	9.0	61.9	20.7	5.8	2.6	100.0	39.6	3.2
	95. Developmental Biology	5.1	65.5	20.2	6.2	3.0	100.0	48.0	3.0
	iv. BIOMEDICAL RESEARCH	**13.5**	**55.0**	**22.4**	**6.6**	**2.5**	**100.0**	**21.7**	**3.3**
R1	**Anatomy & Pathology**	14.6	55.6	20.1	6.6	3.1	100.0	20.9	2.9
	123. Pathology	14.2	54.2	21.5	6.7	3.3	100.0	21.5	3.0
	118. Anatomy & Morphology	16.5	49.2	23.2	7.5	3.6	100.0	12.6	3.1
R2	**Biomaterials & Bioengineering**	15.4	55.1	21.3	6.0	2.2	100.0	21.0	3.2
	120. Engineering, Biomedical	14.1	51.9	23.1	7.2	3.7	100.0	15.1	3.1
	91. Biotechnology & Applied Microbiology	15.8	53.6	21.6	6.5	2.5	100.0	21.9	3.2
R3	**Experimental & Laboratory Med.**	17.2	58.4	17.6	4.7	2.1	100.0	37.6	3.2
	121. Medical Laboratory Technology	19.0	47.7	23.1	6.8	3.3	100.0	14.2	3.2
	122. Medicine, Research & Experimental	17.2	59.3	16.9	4.6	2.1	100.0	44.0	3.1
	24. Microscopy	14.6	53.2	22.4	6.7	3.1	100.0	14.1	3.1
R4	**Pharmacology & Toxicology**	11.9	54.6	23.0	7.1	3.5	100.0	17.5	3.2
	128. Pharmacology & Pharmacy	11.9	53.9	23.0	7.6	3.5	100.0	17.8	3.2
	129. Toxicology	11.2	57.0	22.1	6.5	3.2	100.0	16.1	3.1
R5	**Physiology**	8.2	56.3	23.4	8.0	4.1	100.0	21.3	3.1
	v. CLINICAL MED. I (INTERNAL)	**13.5**	**58.6**	**19.9**	**5.8**	**2.2**	**100.0**	**32.9**	**3.2**
I1	**Cardiovascular & Respiratory Medicine**	13.8	56.9	20.7	6.0	2.7	100.0	30.0	3.1
	131. Cardiac & Cardiovascular Systems	15.0	57.2	19.3	5.9	2.6	100.0	31.8	3.0
	138. Respiratory System	10.9	57.4	21.5	6.9	3.4	100.0	23.4	3.0
I2	**Endocrinology & Metabolism**	6.9	59.2	23.2	7.6	3.1	100.0	27.8	3.2
I3	**General & Internal Medicine**	22.0	55.2	17.4	4.1	1.4	100.0	35.8	3.6
	140. Anesthesiology	16.9	49.8	21.9	7.4	3.9	100.0	15.7	3.0
	141. Critical Care Medicine	12.3	54.8	22.0	7.4	3.6	100.0	24.9	3.0
	132. Emergency Medicine	23.6	47.3	20.2	5.9	3.0	100.0	10.6	2.9
	134. Gastroenterology & Hepatology	12.5	58.0	20.5	6.3	2.7	100.0	26.5	3.1
	136. Medicine, General & Internal	31.0	51.8	12.9	3.2	1.2	100.0	58.7	3.3
	139. Tropical Medicine	18.8	44.5	23.5	9.1	4.1	100.0	10.7	3.0

I4	**Hematology & Oncology**	7.9	62.1	20.9	6.3	2.8	100.0	37.3	3.1
	135. Hematology	8.4	61.6	20.5	6.5	3.0	100.0	41.4	3.0
	137. Oncology	7.8	60.3	22.3	6.7	2.9	100.0	32.5	3.2
I5	**Immunology**	9.9	59.0	21.9	6.5	2.7	100.0	31.6	3.2
	130. Allergy	15.9	52.5	21.3	7.1	3.3	100.0	20.7	2.9
	126. Immunology	8.5	60.4	22.1	6.2	2.7	100.0	34.0	3.3
	127. Infectious Diseases	9.3	56.8	22.9	7.5	3.5	100.0	25.6	3.1
	vi. CLINICAL MED. II (NON-INT.)	**16.3**	**52.3**	**22.0**	**6.5**	**2.9**	**100.0**	**19.3**	**3.2**
M1	**Age & Gender Related Medicine**	15.0	53.2	21.0	7.1	3.7	100.0	16.7	2.9
	143. Geriatrics & Gerontology	14.9	49.8	23.9	7.6	3.9	100.0	17.3	3.1
	145. Obstetrics & Gynaecology	16.4	50.4	22.5	7.2	3.6	100.0	15.3	3.0
	119. Andrology	12.6	54.6	21.8	7.1	3.8	100.0	12.2	3.0
	92. Reproductive Biology	7.9	57.1	23.0	8.1	4.0	100.0	19.7	3.1
	196. Gerontology	16.7	51.6	20.7	6.9	4.0	100.0	16.9	2.8
M2	**Dentistry**	15.6	52.7	20.7	7.7	3.4	100.0	11.8	2.9
M3	**Dermatology & Urogenital System**	16.4	51.4	21.7	7.1	3.4	100.0	18.9	3.0
	142. Dermatology	18.1	48.7	22.1	7.5	3.7	100.0	13.7	3.0
	155. Urology & Nephrology	15.4	54.5	20.6	6.6	3.0	100.0	22.7	2.9
M4	**Ophthalmology & Otorhinolaryngology**	17.4	49.2	22.6	7.4	3.3	100.0	13.6	3.1
	148. Otorhinolaryngology	20.3	47.2	20.7	7.6	4.2	100.0	9.9	2.8
	146. Ophthalmology	15.4	51.0	23.3	7.2	3.1	100.0	16.1	3.2
M5	**Paramedicine**	19.9	46.9	22.2	7.5	3.5	100.0	9.4	2.9
M6	**Psychiatry & Neurology**	14.2	54.9	21.1	6.7	3.1	100.0	23.5	3.0
	157. Clinical Neurology	14.0	56.1	20.8	6.2	3.0	100.0	23.0	3.0
	162. Psychiatry	15.3	53.6	21.2	6.6	3.3	100.0	23.5	3.0
M7	**Radiology & Nuclear Medicine**	15.4	53.3	21.3	6.7	3.2	100.0	18.7	3.0
M8	**Rheumatology & Orthopedics**	18.7	51.3	20.7	6.4	2.9	100.0	15.5	3.0
	147. Orthopedics	17.9	48.6	23.4	6.8	3.3	100.0	13.1	3.2
	151. Rheumatology	11.5	55.8	22.5	7.2	3.1	100.0	24.7	3.1
	152. Sport Sciences	20.0	44.5	22.9	8.6	4.0	100.0	12.8	3.0
	179. Rehabilitation	23.4	46.2	21.0	6.3	3.0	100.0	10.0	2.9
M9	**Surgery**	15.9	54.8	20.5	6.0	2.7	100.0	22.6	3.1
	153. Surgery	18.1	51.7	20.3	6.8	3.0	100.0	15.9	2.9
	154. Transplantation	18.2	50.0	21.9	6.9	3.1	100.0	16.6	3.1
	150. Peripheral Vascular Disease	10.0	59.8	20.8	6.5	2.9	100.0	38.7	3.0
M10	**Pediatrics**	20.4	48.1	22.3	6.4	2.8	100.0	14.0	3.2
	vii. NEUROSIENCES & BEHAVIOR	**13.5**	**55.1**	**21.8**	**6.6**	**3.0**	**100.0**	**23.5**	**3.1**
N1	**Neurosciences & Psycopharmacology**	9.1	58.5	22.4	6.7	3.3	100.0	29.4	3.2
	158. Neuroimaging	18.4	52.0	20.0	6.4	3.2	100.0	26.8	2.9
	159. Neurosciences	8.9	58.2	22.7	6.8	3.4	100.0	29.5	3.2
N2	**Psychology & Behavioral Sciences**	17.9	51.3	21.2	6.4	3.1	100.0	15.2	3.0

	156. Behavioral Sciences	5.1	57.7	24.5	8.6	4.1	100.0	16.8	3.3
	160. Psychology, Biological	7.5	59.6	22.8	7.0	3.1	100.0	15.5	3.2
	163. Psychology	12.4	52.4	23.4	7.9	3.8	100.0	16.5	3.1
	164. Psychology, Applied	23.4	44.9	21.5	6.6	3.5	100.0	10.2	2.9
	165. Psychology, Clinical	13.2	55.4	21.4	6.9	3.1	100.0	17.3	3.0
	166. Psychology, Developmental	11.3	55.4	23.0	7.1	3.3	100.0	17.0	3.1
	167. Psychology, Educational	22.3	48.9	19.3	6.3	3.2	100.0	13.3	2.8
	168. Psychology, Experimental	14.2	53.9	21.8	6.7	3.3	100.0	17.4	3.0
	169. Psychology, Mathematical	20.0	50.8	19.7	6.1	3.4	100.0	12.9	2.9
	170. Psychology, Multidisciplinary	28.3	42.9	20.7	5.7	2.4	100.0	13.1	3.2
	171. Psychology, Psychoanalysis	41.3	29.0	20.9	5.8	3.0	100.0	7.1	3.0
	172. Psychology, Social	15.2	55.5	19.8	6.4	3.0	100.0	15.1	2.9
	161. Social Sciences, Biomedical	17.7	52.7	20.3	6.4	2.8	100.0	12.6	3.0
	viii. CHEMISTRY	**22.1**	**48.4**	**20.8**	**5.9**	**2.7**	**100.0**	**16.0**	**3.0**
C0	**Multidisciplinary Chemistry**	23.3	49.5	18.3	6.0	2.8	100.0	24.6	2.8
C1	**Analytical, Inorganic & Nuclear Chem.**	14.1	54.1	21.4	7.3	3.1	100.0	16.6	3.0
	55. Chemistry, Inorganic & Nuclear	15.9	49.2	23.2	8.0	3.7	100.0	14.6	3.0
	53. Chemistry, Analytical	13.9	54.2	22.2	6.7	3.0	100.0	17.2	3.1
C2	**Applied Chem. & Chem. Engineering**	30.5	38.5	20.1	7.5	3.5	100.0	11.0	2.7
	54. Chemistry, Applied	22.1	44.7	22.4	7.1	3.7	100.0	12.4	3.0
	31. Engineering, Chemical	34.5	32.6	22.1	7.5	3.3	100.0	9.6	3.0
C3	**Organic & Medicinal Chemistry**	10.5	53.4	24.5	8.0	3.6	100.0	16.3	3.2
	56. Chemistry, Medicinal	9.8	57.2	22.8	6.9	3.3	100.0	16.2	3.1
	58. Chemistry, Organic	10.2	52.5	25.5	7.9	3.9	100.0	16.1	3.3
C4	**Physical Chemistry**	13.5	52.7	23.4	7.2	3.3	100.0	17.3	3.2
	59. Chemistry, Physical	13.4	52.8	23.2	7.2	3.4	100.0	17.5	3.2
	60. Electrochemistry	14.3	51.5	23.2	7.5	3.4	100.0	16.2	3.1
C5	**Polymer Science**	19.4	46.1	23.2	7.7	3.5	100.0	13.9	3.1
C6	**Materials Science**	30.5	41.4	19.2	6.4	2.5	100.0	11.9	2.9
	3. Materials Science, Biomaterials	7.2	58.2	22.7	8.1	3.9	100.0	19.8	3.0
	4. Materials Science, Ceramics	37.5	32.6	20.5	6.4	3.0	100.0	9.1	2.8
	5. Materials Science, Characterization & Testir	57.5	16.5	17.7	5.6	2.6	100.0	4.5	2.7
	6. Materials Science, Coatings & Films	18.4	48.4	22.6	7.0	3.6	100.0	12.3	3.0
	7. Materials Science, Composites	36.2	31.9	22.1	6.9	2.9	100.0	6.3	2.9
	8. Materials Science, Multidisciplinary	26.6	42.7	22.0	6.2	2.6	100.0	12.3	3.2
	9. Materials Science, Paper & Wood	50.2	17.0	21.4	7.3	4.2	100.0	4.5	2.7
	10. Materials Science, Textiles	45.7	20.1	22.8	8.2	3.2	100.0	4.6	3.0
	11. Metallurgy & Metallurgical Engineering	39.5	33.4	19.0	5.6	2.5	100.0	9.4	2.8
	12. Nanoscience & Nanotechnology	19.8	49.0	22.2	6.5	2.5	100.0	14.5	3.2
	ix. PHYSICS	**20.7**	**50.3**	**20.6**	**6.0**	**2.4**	**100.0**	**17.5**	**3.2**
P0	**Multidisciplinary Physics**	24.2	49.8	18.8	5.2	2.0	100.0	23.1	3.2

	47. Physics, Multidisciplinary	26.5	49.4	17.2	4.9	2.0	100.0	27.2	3.0
	50. Spectroscopy	17.7	49.0	23.1	6.8	3.3	100.0	13.2	3.1
P1	**Applied Physics**	22.4	48.9	20.5	5.8	2.4	100.0	14.2	3.1
	39. Acoustics	22.9	40.4	24.2	7.9	4.6	100.0	8.7	3.1
	40. Crystallography	26.9	46.7	20.5	5.0	1.0	100.0	12.1	3.6
	41. Optics	23.8	46.7	19.9	6.5	3.0	100.0	13.7	2.9
	42. Physics, Applied	21.0	48.6	21.3	6.4	2.8	100.0	14.6	3.1
P2	**Atomic, Molecular & Chem. Physics**	9.1	57.0	23.0	7.5	3.3	100.0	18.4	3.1
P3	**Classical Physics**	23.2	44.4	21.1	7.6	3.7	100.0	7.8	2.8
P4	**Mathematics & Theoretical Physics**	18.9	48.5	22.5	7.1	3.0	100.0	13.5	3.1
P5	**Particle & Nuclear Physics**	20.5	51.1	20.5	5.8	2.2	100.0	22.5	3.3
	48. Physics, Nuclear	25.4	47.5	19.1	5.6	2.5	100.0	14.1	2.9
	49. Physics, Particles & Fields	20.2	52.3	20.0	5.4	2.1	100.0	26.2	3.3
P6	**Physics of Solids, Fluids & Plasmas**	20.5	46.6	23.2	6.8	2.9	100.0	14.0	3.2
	44. Physics, Condensed Matter	22.5	46.7	21.7	6.3	2.8	100.0	14.1	3.1
	45. Physics, Fluids & Plasmas	11.4	57.1	21.6	6.8	3.1	100.0	16.1	3.0
	x. GEOSCIENCES & SPACE SCS.	**22.3**	**47.8**	**20.5**	**6.6**	**2.8**	**100.0**	**18.9**	**3.0**
G1	**Astronomy & Astrophysics**	15.8	54.0	21.2	6.4	2.7	100.0	28.6	3.1
G2	**Geosiences & Technology**	20.0	46.2	23.2	7.3	3.3	100.0	13.2	3.1
	73. Geochemistry & Geophysics	15.3	52.3	21.7	7.3	3.5	100.0	16.5	2.9
	74. Geography, Physical	13.4	51.7	23.3	7.9	3.8	100.0	13.7	3.1
	75. Geology	18.6	46.4	22.5	8.3	4.1	100.0	12.7	2.9
	76. Geosciences, Multidisciplinary	21.9	47.3	20.7	6.8	3.3	100.0	12.6	2.9
	25. Imaging Science & Photographic Technol	28.6	43.4	19.7	5.8	2.5	100.0	14.4	3.0
	29. Engineering, Geological	28.3	35.4	23.2	9.3	3.8	100.0	5.8	2.9
	80. Paleontology	20.8	44.8	23.0	7.8	3.6	100.0	10.7	3.0
	81. Remote Sensing	19.5	48.6	21.3	7.5	3.0	100.0	12.8	3.0
G3	**Hydrology & Oceanography**	17.6	45.5	24.2	8.2	4.4	100.0	14.6	3.0
	79. Oceanography	15.0	50.2	22.5	8.1	4.2	100.0	15.7	2.9
	35. Engineering, Ocean	39.7	29.8	21.6	6.3	2.5	100.0	7.2	3.1
G4	**Meteo., Atmos. & Aerosp. Sci. & Tech.**	37.0	35.6	19.2	5.7	2.6	100.0	15.1	2.8
	77. Meteorology & Atmospheric Sciences	14.5	52.3	22.2	7.6	3.4	100.0	18.0	3.0
	32. Engineering, Aerospace	68.0	0.0	22.9	5.8	3.3	100.0	3.1	2.2
G5	**Mineralogy & Petrology**	32.2	38.8	19.1	6.6	3.2	100.0	10.9	2.7
	78. Mineralogy	19.6	49.0	21.2	6.7	3.5	100.0	12.4	2.9
	30. Mining & Mineral Processing	45.9	25.1	20.7	5.6	2.7	100.0	7.3	3.0
	xi. ENGINEERING	37.0	36.0	19.1	5.6	2.3	100.0	9.4	2.9
E1	**Computer Science & Information Tech.**	37.7	36.4	19.0	5.0	1.8	100.0	10.3	3.2
	65. Computer Science, Artificial Intelligence	33.9	36.0	21.4	6.1	2.6	100.0	10.6	3.2
	66. Computer Science, Cybernetics	45.1	26.2	20.4	5.5	2.8	100.0	7.1	2.9
	67. Computer Science, Hardware & Architectu	40.4	29.2	22.1	6.2	2.2	100.0	8.3	3.3

	68. Computer Science, Information Systems	39.3	36.5	17.0	5.0	2.2	100.0	10.9	2.9
	69. Computer Science, Interdisciplinary Appli	29.8	44.9	18.8	5.1	1.4	100.0	14.0	3.4
	70. Computer Science, Software Engineering	42.5	29.2	19.9	5.9	2.5	100.0	7.3	2.9
	71. Computer Science, Theory & Methods	45.0	28.7	18.9	5.3	2.0	100.0	7.4	3.0
	72. Mathematical & Computational Biology	12.6	62.9	19.7	3.7	1.0	100.0	25.3	4.3
E2	**Electrical & Electronic Engineering**	36.4	35.9	19.4	5.8	2.5	100.0	9.6	2.9
	1. Engineering, Electrical & Electronic	35.9	36.0	19.6	5.9	2.6	100.0	9.6	3.0
	2. Telecommunications	49.9	24.5	18.7	4.8	2.1	100.0	8.2	3.1
E3	**Energy & Fuels**	39.0	27.1	23.5	7.0	3.4	100.0	7.3	3.1
	26. Energy & Fuels	45.6	23.1	20.8	7.4	3.2	100.0	7.8	2.8
	27. Nuclear Science & Technology	30.9	40.6	19.9	6.1	2.5	100.0	8.3	2.9
	28. Engineering, Petroleum	78.6	0.0	15.8	3.8	1.9	100.0	3.0	2.3
E4	**General & Traditional Engineering**	34.4	37.2	18.8	6.5	3.1	100.0	8.9	2.7
	13. Construction & Building Technology	35.4	34.0	19.4	7.8	3.5	100.0	5.7	2.6
	14. Engineering, Civil	43.8	28.5	19.2	5.8	2.6	100.0	6.3	2.7
	15. Engineering, Environmental	21.8	49.1	20.1	6.0	3.0	100.0	16.1	2.9
	16. Engineering, Marine	93.0	0.0	5.1	1.3	0.5	100.0	2.3	2.2
	17. Transportation Science & Technology	56.9	16.3	16.8	6.8	3.3	100.0	4.9	2.5
	18. Engineering, Industrial	41.6	19.3	25.6	9.6	4.0	100.0	4.6	3.1
	19. Engineering, Manufacturing	36.8	33.1	18.8	6.9	4.4	100.0	5.7	2.5
	20. Engineering, Mechanical	36.2	31.4	21.8	7.2	3.4	100.0	6.5	2.9
	21. Mechanics	26.2	40.2	22.2	7.3	4.0	100.0	8.7	3.0
	22. Robotics	38.9	32.4	19.8	6.1	2.8	100.0	6.3	2.8
	23. Instruments & Instrumentation	34.3	34.6	20.3	7.3	3.5	100.0	9.0	2.8
	33. Automation & Control Systems	41.5	27.1	22.7	6.2	2.5	100.0	7.1	3.1
	34. Engineering, Multidisciplinary	45.0	27.4	19.3	5.6	2.8	100.0	7.3	2.9
	36. Ergonomics	22.6	45.0	21.5	7.3	3.6	100.0	7.5	2.9
	38. Operations Research & Management Scier	31.0	33.8	24.1	7.6	3.5	100.0	6.4	3.1
	xii. MATHEMATICS	**35.6**	**32.3**	**23.3**	**6.6**	**2.2**	**100.0**	**7.3**	**3.4**
H1	**Applied Mathematics**	31.7	40.7	20.0	5.7	1.9	100.0	9.5	3.2
	63. Mathematics, Applied	35.6	32.5	21.2	7.6	3.1	100.0	6.8	2.9
	64. Statistics & Probability	28.7	46.4	19.5	4.3	1.1	100.0	14.1	3.8
	37. Mathematics, Interdisciplinary Application	23.3	47.9	19.7	5.9	3.1	100.0	10.6	2.9
H2	**Pure Mathematics**	41.6	20.9	25.2	8.5	3.7	100.0	4.5	3.2

Table E1. Power Law Estimation Results. Thomson Scientific Sub-fields, and Tijssen and van Leeuwen Disciplines and Fields

	α	ρ	*p*-value	No. of Power Lav Articles	% of Total Articles	% of Citations
	(1)	(2)	(3)	(4)	(5)	(6)
i. ENGINEERING	**3.40**	**21**	**0.00**	**14,702**	**2.24**	**21.7**
1. Electrical Engineering	**3.39**	**23**	**0.03**	**2,182**	**1.69**	**19.3**
1. Engineering, Electrical & Electronic	3.39	23	0.01	2,150	1.72	19.4
2 Telecommunications	3.25	21	0.81	360	1.54	22.7
2. Materials Science	**3.61**	**40**	**0.01**	**1,673**	**0.74**	**11.0**
3 Materials Science, Biomaterials	4.48	40	0.57	148	2.25	13.2
4 Materials Science, Ceramics	4.49	22	0.35	295	1.47	13.5
5. Materials Sc., Charac. & Testing	3.58	8	0.02	228	3.45	31.2
6 Materials Science, Coatings & Films	3.61	16	0.00	1,574	7.06	32.2
7 Materials Science, Composite	3.94	12	0.80	278	2.91	20.9
8 Materials Science, Multidisciplinary	3.37	33	0.00	2,026	1.47	17.1
9 Materials Science, Paper & Wood	3.40	6	0.00	588	8.08	43.9
10 Materials Science, Textiles	3.78	11	0.68	107	2.08	19.5
11 Metallurgy & Metallurgical Eng.	3.92	33	0.88	249	0.61	9.7
12 Nanoscience & Nanotechnology	3.04	19	0.00	1,139	5.93	35.4
3. Civil Engineering	**3.86**	**31**	**0.10**	**568**	**1.15**	**14.4**
13 Construction & Building Tech.	4.22	10	0.02	307	3.48	21.4
14 Engineering, Civil	4.16	17	0.90	256	1.11	12.4
15 Engineering, Environmental	3.82	31	0.09	537	2.55	19.7
16 Engineering, Marine	2.80	3	0.34	52	1.86	58.7
17 Transportation Science & Tech.	3.60	8	0.24	268	4.45	35.8
4. Mechanical Engineering	**4.18**	**22**	**0.36**	**887**	**0.91**	**10.0**
18 Engineering, Industrial	3.79	8	0.03	764	5.40	31.2
19 Engineering, Manufacturing	4.43	12	0.48	271	1.87	13.8
20 Engineering, Mechanical	4.02	18	0.60	481	1.17	12.0
21 Mechanics	4.21	22	0.17	668	1.54	13.1
22 Robotics	3.35	8	0.04	227	7.08	38.5
5. Instruments	**3.78**	**21**	**0.16**	**1,168**	**2.40**	**19.8**
23 Instruments & Instrumentation	3.96	20	0.57	844	2.09	17.9
24 Microscopy	3.65	19	0.02	254	6.36	29.6
25 Imaging Sc. & Photographic Tech.	3.37	24	0.76	176	3.59	28.0
6. Fuels and Energy	**3.72**	**18**	**0.14**	**1,316**	**1.91**	**18.4**

26 Energy & Fuels	3.66	20	0.46	477	1.58	17.8
27 Nuclear Science & Technology	3.77	17	0.31	799	2.17	18.1
28 Engineering, Petroleum	4.06	9	0.12	160	1.39	26.6
7. Geological Engineering	**3.02**	**7**	**0.01**	**1,141**	**9.95**	**48.5**
29 Engineering, Geological	3.55	7	0.31	439	9.44	38.4
30 Mining & Mineral Processing	3.49	16	0.62	175	2.38	24.4
8. Chemical Engineering	**4.27**	**33**	**0.95**	**457**	**0.68**	**8.5**
31 Engineering, Chemical	4.27	33	0.95	457	0.68	8.5
9. Aerospace Engineering	**4.71**	**12**	**0.52**	**191**	**0.94**	**14.9**
32 Engineering, Aerospace	4.71	12	0.52	191	0.94	14.9
10. Other Engineering	**3.71**	**19**	**0.11**	**1,167**	**1.59**	**16.1**
33 Automation & Control Systems	3.15	10	0.03	1,005	5.80	37.7
34 Engineering, Multidisciplinary	3.70	17	0.78	410	1.80	19.7
35 Engineering, Ocean	3.25	11	0.42	177	5.10	35.8
36 Ergonomics	3.40	8	0.01	331	10.88	40.9
37 Mathematics, Interdis. Applications	4.33	32	0.20	160	0.91	10.0
38 Operations Research & Managemer	3.60	10	0.00	1,026	5.51	30.5
ii. PHYSICS & ASTRONOM	**3.37**	**56**	**0.43**	**5,817**	**0.99**	**13.8**
11 Physics	**3.40**	**58**	**0.49**	**4,338**	**0.80**	**12.3**
39 Acoustics	4.03	18	0.95	387	2.64	17.4
40 Crystallography	3.07	13	0.04	1,700	6.00	40.5
41 Optics	3.66	28	0.16	1,240	2.31	19.3
42 Physics, Applied	3.71	56	0.11	742	0.59	9.0
43 Ph., Atomic, Molec. & Chemical	3.92	43	0.93	895	1.47	11.1
44 Physics, Condensed Matter	3.58	30	0.02	2,415	2.26	19.5
45 Physics, Fluids & Plasmas	3.69	24	0.01	1,095	4.54	23.6
46 Physics, Mathematical	3.45	22	0.72	1,397	4.13	26.2
47 Physics, Multidisciplinary	3.33	81	0.32	819	0.98	16.9
48 Physics, Nuclear	3.53	26	0.25	700	2.76	22.8
49 Physics, Particles & Fields	3.38	94	0.68	299	0.76	14.1
50 Spectroscopy	3.90	31	0.65	511	1.71	14.2
51 Thermodynamics	3.74	12	0.16	796	4.50	24.3
12. Space Science	**3.46**	**72**	**0.34**	**878**	**1.47**	**15.3**
52 Astronomy & Astrophysics	3.46	72	0.34	878	1.47	15.3
iii. CHEMISTRY	**4.31**	**89**	**0.73**	**1,015**	**0.21**	**3.6**
13. Chemistry	**4.31**	**89**	**0.75**	**1,015**	**0.21**	**3.6**
53 Chemistry, Analytical	4.01	42	0.80	966	1.42	12.2
54 Chemistry, Applied	3.79	21	0.05	1,284	3.70	21.9
55 Chemistry, Inorganic & Nuclear	4.08	29	0.18	1,201	2.45	15.7

56 Chemistry, Medicinal	3.83	27	0.58	890	3.63	20.1
57 Chemistry, Multidisciplinary	4.18	87	0.68	570	0.56	8.4
58 Chemistry, Organic	4.02	32	0.77	1,914	2.46	14.6
59 Chemistry, Physical	3.68	33	0.00	3,673	2.93	19.3
60 Electrochemistry	4.55	40	0.29	276	1.36	10.1
61 Polymer Science	3.69	35	0.26	917	1.60	14.4
iv. MATHEMATICS	**3.14**	**13**	**0.37**	**3,973**	**3.20**	**29.3**
14. Mathematics	**3.72**	**14**	**0.00**	**2,002**	**1.93**	**17.9**
62 Mathematics	3.84	12	0.00	1,250	1.89	17.1
63 Mathematics, Applied	3.55	13	0.00	1,654	3.12	23.9
15. Statistics	**2.64**	**13**	**0.09**	**1,588**	**6.84**	**49.0**
64 Statistics & Probability	2.64	13	0.09	1,588	6.84	49.0
v. COMPUTER SCIENCE	**3.07**	**40**	**0.93**	**656**	**0.55**	**13.1**
16. Computer Science	**3.07**	**40**	**0.93**	**656**	**0.55**	**13.1**
65 Computer Science, Artificial Intellig	3.33	29	0.53	372	1.57	19.9
66 Computer Science, Cybernetics	2.99	8	0.02	388	8.27	47.6
67 Computer Science, Hardware & Ar	3.01	14	0.42	532	4.01	35.7
68 Comp. Sc., Information Systems	3.11	19	0.00	666	3.15	32.6
69 Comp. Sc., Interd. Applications	2.80	17	0.20	1,334	4.85	41.9
70 Comp. Sc., Software Engineering	3.69	19	0.49	288	1.52	17.8
71 Comp. Sc., Theory & Methods	3.19	13	0.48	1,062	3.19	30.9
72 Math. & Computational Biology	2.60	14	0.56	1,011	13.65	59.7
vi. EARTH & ENVIRON.	**4.05**	**36**	**0.16**	**3,441**	**1.43**	**11.9**
17 Geosciences	**3.99**	**33**	**0.24**	**2,352**	**1.83**	**14.0**
73 Geochemistry & Geophysics	4.35	40	0.57	315	1.21	9.9
74 Geography, Physical	4.13	26	0.50	244	2.77	16.0
75 Geology	3.71	17	0.23	566	7.21	32.2
76 Geosciences, Multidisciplinary	3.95	26	0.05	1,001	2.17	16.2
77 Meteorology & Atmospheric Scienc	3.75	35	0.93	754	2.75	19.2
78 Mineralogy	3.40	14	0.01	648	8.74	37.6
79 Oceanography	4.24	24	0.47	924	4.81	22.5
80 Paleontology	3.85	25	0.83	103	1.55	12.4
81 Remote Sensing	3.19	13	0.85	530	10.54	44.3
18. Environmental Scs. & Ecology	**4.12**	**36**	**0.21**	**1,896**	**1.43**	**11.6**
82 Biodiversity Conservation	3.44	18	0.23	511	7.83	37.6
83 Ecology	4.15	36	0.43	887	2.17	13.8
84 Environmental Sciences	4.02	37	0.54	960	1.36	11.7
85 Limnology	4.67	29	0.52	155	2.81	15.8
86 Soil Science	4.61	22	0.09	299	2.10	13.2

87 Water Resources	4.16	19	0.39	650	2.52	16.0
vii. BIOLOGY & BIOCH.	**3.74**	**143**	**0.81**	**1,992**	**0.41**	**6.8**
19. Basic Life Sciences	**3.54**	**123**	**0.95**	**1,922**	**0.62**	**8.9**
88 Biochemical Research Methods	3.14	24	0.17	2,312	6.88	35.7
89 Biochemistry & Molecular Biology	3.60	125	0.95	1,721	0.81	10.0
90 Biophysics	4.00	63	0.08	601	1.23	11.1
91 Biotechnology & Applied Microbiol	3.17	39	0.00	1,957	3.02	24.8
92 Reproductive Biology	5.28	56	0.80	133	0.80	6.1
20. Mol. Biology & Genetics	**3.85**	**153**	**0.05**	**1,237**	**0.82**	**10.5**
93 Cell Biology	3.79	148	0.05	1,063	1.27	13.4
94 Genetics & Heredity	3.84	133	0.40	534	0.85	11.0
95 Developmental Biology	3.45	68	0.00	860	5.11	29.1
21. Microbiology	**4.32**	**67**	**0.52**	**850**	**0.98**	**8.4**
96 Microbiology	3.74	38	0.01	2,222	3.96	21.3
97 Parasitology	4.11	24	0.21	332	3.07	17.7
98 Virology	4.33	66	0.30	367	1.79	11.4
viii. AGRIC. & FOOD SCS.	**4.46**	**70**	**0.82**	**513**	**0.16**	**3.0**
22. Biology	**3.74**	**39**	**0.48**	**1,073**	**2.99**	**19.9**
99 Biology	4.04	43	0.05	460	1.88	15.7
100 Biology, Miscellaneous	3.59	10	0.65	39	9.22	40.7
101 Evolutionary Biology	3.43	27	0.46	1,144	10.43	37.0
23. Agricultural Sciences	**3.83**	**32**	**0.00**	**1,470**	**1.50**	**13.8**
102 Agricultural Engineering	3.68	9	0.24	387	8.82	35.6
103 Agriculture, Multidisciplinary	3.52	19	0.01	636	4.31	27.5
104 Agronomy	4.48	26	0.60	331	1.40	12.2
105 Food Science & Technology	3.92	21	0.05	1,309	2.93	18.4
106 Nutrition & Dietetics	3.72	37	0.00	656	2.98	20.6
24. Plant and Animal Sciences	**4.18**	**55**	**0.76**	**772**	**0.32**	**4.9**
107 Agriculture, Dairy & Animal Scien	4.12	18	0.10	621	2.86	19.7
108 Entomology	4.59	21	0.64	293	1.51	11.3
109 Fisheries	4.99	25	0.48	201	1.29	8.2
110 Forestry	3.65	15	0.51	753	6.81	30.6
111 Horticulture	4.43	25	0.01	201	1.99	15.4
112 Marine & Freshwater Biology	4.88	24	0.55	740	2.29	12.1
113 Mycology	3.60	16	0.99	394	6.63	34.2
114 Ornithology	3.58	14	0.39	203	4.67	26.1
115 Plant Sciences	4.41	67	0.42	323	0.51	6.6
116 Veterinary Sciences	3.93	22	0.30	830	1.61	14.9
117 Zoology	4.02	22	0.10	1,067	3.18	19.0

ix. BIOMEDICAL SCS.	**3.30**	**48**	**0.00**	**9,726**	**2.43**	**20.5**
25. Biomedical	**3.12**	**46**	**0.01**	**5,244**	**2.64**	**23.2**
118 Anatomy & Morphology	3.78	21	0.65	246	4.02	22.6
119 Andrology	3.52	12	0.62	185	12.96	43.9
120 Engineering, Biomedical	4.23	36	0.51	296	1.52	11.6
121 Medical Laboratory Technology	3.08	16	0.00	932	9.03	42.4
122 Medicine, Research & Experiment	3.54	135	0.03	465	1.08	17.4
123 Pathology	3.85	48	0.61	598	2.06	16.9
124 Physiology	5.46	53	0.19	450	1.04	6.7
125 Radiology, Nuclear Medicine Imaging	3.80	46	0.38	853	1.57	14.4
26. Immunology	**3.51**	**81**	**0.08**	**1,522**	**1.56**	**15.4**
126 Immunology	3.40	73	0.02	1,833	2.24	19.3
127 Infectious Diseases	3.78	45	0.03	1,079	3.35	19.8
27. Pharmacology & Toxicology	**4.24**	**55**	**0.42**	**980**	**0.79**	**8.0**
128 Pharmacology & Pharmacy	4.24	55	0.23	871	0.86	8.5
129 Toxicology	3.65	26	0.00	1,157	3.76	21.1
x. CLINICAL MEDICINE	**3.33**	**84**	**0.30**	**7,070**	**0.71**	**11.3**
28. General & Internal	**3.11**	**94**	**0.27**	**3,872**	**1.10**	**16.0**
130 Allergy	3.88	44	0.37	195	2.14	16.6
131 Cardiac & Cardiovascular Systems	3.17	49	0.00	2,318	4.19	31.3
132 Emergency Medicine	3.60	19	0.58	205	3.00	21.9
133 Endocrinology & Metabolism	3.54	49	0.44	1,511	3.10	19.4
134 Gastroenterology & Hepatology	3.33	42	0.03	1,414	4.01	27.1
135 Hematology	3.46	69	0.00	1,517	3.61	24.5
136 Medicine, General & Internal	2.85	172	0.41	653	1.00	29.0
137 Oncology	3.62	78	0.47	1,298	1.60	14.6
138 Respiratory System	4.11	52	0.23	499	1.76	13.1
139 Tropical Medicine	3.80	15	0.08	473	6.90	31.1
29. Non-internal	**3.70**	**62**	**0.06**	**3,042**	**0.82**	**10.2**
140. Anesthesiology	4.09	32	0.04	434	2.57	17.5
141. Critical Care Medicine	4.29	58	0.27	243	1.83	14.2
142. Dermatology	3.65	22	0.00	982	4.57	26.4
143. Geriatrics & Gerontology	3.92	26	0.11	533	5.64	27.4
144. Integrative & Complementary Mec	3.90	12	0.26	193	7.69	31.7
145. Obstetrics & Gynecology	4.77	52	0.56	173	0.53	5.6
146. Ophthalmology	3.82	35	0.01	563	2.15	16.6
147. Orthopedics	4.39	39	0.60	227	0.93	8.9
148. Otorhinolaryngology	4.08	16	0.00	747	4.25	22.5

149. Pediatrics	3.85	42	0.70	417	0.97	10.9
150. Peripheral Vascular Disease	3.36	64	0.01	1,336	3.63	25.1
151. Rheumatology	3.50	36	0.65	545	5.11	28.3
152. Sport Sciences	3.72	18	0.00	1,389	6.61	31.0
153. Surgery	4.17	51	0.07	752	0.72	8.3
154. Transplantation	3.94	48	0.80	231	1.09	11.5
155. Urology & Nephrology	3.72	45	0.18	821	2.44	18.7
30. Neurosciences & Behavior	**5.04**	**136**	**0.29**	**318**	**0.18**	**2.9**
156. Behavioral Sciences	3.80	23	0.03	917	6.29	24.7
157. Clinical Neurology	4.19	67	0.73	640	0.95	10.0
158. Neuroimaging	3.69	47	0.14	209	3.32	23.8
159. Neurosciences	5.21	136	0.18	277	0.25	3.4
160. Psychology, Biological	3.27	15	0.16	476	11.86	40.4
161. Social Sciences, Biomedical	3.51	19	0.42	288	4.52	26.7
31. Psychiatry & Psychology	**4.13**	**65**	**0.50**	**651**	**0.53**	**7.2**
162. Psychiatry	4.06	65	0.22	478	1.09	10.9
163. Psychology	3.84	27	0.04	677	4.17	21.7
164. Psychology, Applied	4.62	21	0.73	212	2.40	16.0
165. Psychology, Clinical	3.95	34	0.43	451	2.50	17.4
166. Psychology, Developmental	3.72	25	0.01	536	5.31	26.6
167. Psychology, Educational	3.34	15	0.00	449	8.35	39.9
168. Psychology, Experimental	4.84	53	0.45	128	0.82	7.8
169. Psychology, Mathematical	2.81	9	0.03	316	17.95	59.2
170. Psychology, Multidisciplinary	2.97	16	0.00	1,262	6.65	42.0
171. Psychology, Psychoanalysis	3.03	8	0.09	219	8.80	48.0
172. Psychology, Social	3.79	24	0.23	399	4.10	24.2
32. Dentistry	**3.87**	**17**	**0.03**	**1,105**	**5.24**	**25.4**
173. Dentistry & Oral Surgery	3.87	17	0.03	1,105	5.24	25.4
33. Health Sciences	**4.48**	**55**	**0.29**	**394**	**0.40**	**5.2**
174. Health Care Sciences & Services	3.63	27	0.44	356	2.42	18.1
175. Health Policy & Services	3.15	16	0.18	821	8.34	39.9
176. Medicine, Legal	3.31	12	0.26	329	7.51	35.3
177. Nursing	3.67	9	0.10	636	6.98	31.8
178. Public, Environ. & Occupational I	4.00	38	0.01	904	1.79	14.3
179. Rehabilitation	4.25	20	0.01	331	2.34	16.0
180. Substance Abuse	3.61	17	0.00	830	10.58	37.2
34. Other Clinical Medicine	**3.39**	**15**	**0.58**	**552**	**3.77**	**27.5**
181. Education, Scientific Disciplines	4.21	18	0.59	142	1.73	15.6
182. Medical Informatics	3.11	13	0.96	439	6.82	38.5

xi. MULTIDISCIPLINARY	**3.25**	**34**	**0.15**	**421**	**1.32**	**22.4**
35. Multidisciplinary	3.25	34	0.15	421	1.32	22.4
183. Multidisciplinary Sciences	3.25	34	0.15	421	1.32	22.4
xii. SOCIAL SCIENCES	**4.23**	**36**	**0.03**	**851**	**0.40**	**7.0**
36. General	**4.15**	**28**	**0.46**	**978**	**0.63**	**8.9**
184. Anthropology	3.38	9	0.00	632	8.23	42.3
185. Area Studies	4.95	10	0.52	45	1.06	11.2
186. Communication	3.01	6	0.00	785	15.33	54.8
187. Criminology & Penology	4.50	17	0.16	103	2.82	21.6
188. Demography	2.51	5	0.00	632	27.29	74.9
189. Education & Educational Researcl	3.42	9	0.04	799	4.81	31.6
190. Education, Special	4.07	14	0.33	134	4.41	24.4
191. Environmental Studies	3.64	11	0.10	610	6.13	29.5
192. Ethics	3.99	10	0.45	164	3.44	23.4
193. Ethnic Studies	3.00	6	0.68	71	7.95	49.3
194. Family Studies	4.26	19	0.55	142	2.72	18.0
195. Geography	3.20	10	0.05	610	10.94	44.5
196. Gerontology	4.36	30	0.52	240	3.45	20.6
197. History Of Social Sciences	4.60	6	0.71	62	3.70	21.8
198. Information Science & Library Sci	3.05	12	0.34	462	4.27	38.1
199. International Relations	2.85	8	0.02	506	6.36	47.4
200. Law	4.32	24	0.43	136	1.03	12.6
201. Linguistics	3.40	12	0.04	500	7.81	39.2
202. Medical Ethics	3.69	10	0.58	103	9.36	39.2
203. Planning & Development	3.58	13	0.66	255	3.70	26.8
204. Political Science	3.97	22	0.70	122	0.72	12.9
205. Public Administration	3.83	10	0.52	176	4.66	28.5
206. Social Issues	3.29	10	0.32	230	4.42	33.8
207. Social Sciences, Interdisciplinary	3.91	14	0.08	212	2.30	20.0
208. Social Work	5.50	17	0.64	63	1.28	10.0
209. Sociology	3.82	19	0.45	238	1.83	18.6
210. Transportation	4.35	12	0.15	103	5.35	25.2
211. Urban Studies	3.23	8	0.00	471	9.99	42.7
212. Women's Studies	3.39	10	0.47	211	5.35	32.2
37. Economics	**2.85**	**9**	**0.00**	**3,930**	**9.71**	**48.6**
213. Agricultural Economics & Policy	3.94	8	0.48	134	7.57	33.2
214. Economics	2.83	9	0.00	3,616	9.74	49.1
215. Industrial Relations & Labor	3.52	8	0.51	251	11.09	45.8
216. Social Sciences, Mathematical Metl	3.07	13	0.00	370	6.82	38.7

38. Business & Management	**5.20**	**46**	**0.93**	**120**	**0.33**	**6.3**
217. Business	4.69	36	0.18	108	0.83	11.2
218. Business, Finance	2.66	10	0.00	876	6.93	58.9
219. Management	3.65	23	0.00	408	2.89	23.1

Table E2. Power Law Estimation Results. Thomson Scientific Sub-fields, and Glänzel and Schubert Disciplines and Fields

		α	ρ	*p*-value	No. of Power Law Articles	% of Total Articles	% of Citations
		(1)	(2)	(3)	(4)	(5)	(6)
	i. AGRIC. AND ENVIRON.	**4.58**	**62**	**0.72**	**464**	**0.21**	**3.5**
A1	**Agricultural Science & Technology**	**4.26**	**29**	**0.21**	**478**	**1.12**	**10.9**
	102. Agricultural Engineering	3.68	9	0.24	387	8.82	35.6
	103. Agriculture, Multidisciplinary	3.52	19	0.01	636	4.31	27.5
	104. Agronomy	4.48	26	0.60	331	1.40	12.2
A2	**Plant & Animal Science & Technology**	**4.87**	**30**	**0.86**	**240**	**1.22**	**9.1**
	85. Limnology	4.67	29	0.52	155	2.81	15.8
	86. Soil Science	4.61	22	0.09	299	2.10	13.2
A3	**Environmental Science & Technology**	4.01	36	0.35	1,053	1.28	11.5
	82. Biodiversity Conservation	3.44	18	0.23	511	7.83	37.6
	84. Environmental Sciences	4.02	37	0.54	960	1.36	11.7
	191. Environmental Studies	3.64	11	0.10	610	6.13	29.5
A4	**Food & Animal Science & Technology**	**3.81**	**32**	**0.00**	**1,437**	**1.56**	**14.1**
	105. Food Science & Technology	3.92	21	0.05	1,309	2.93	18.4
	106. Nutrition & Dietetics	3.72	37	0.00	656	2.98	20.6
	107. Agriculture, Dairy & Animal Science	4.12	18	0.10	621	2.86	19.7
	111. Horticulture	4.43	25	0.01	201	1.99	15.4
	ii. BIOLOGY	**4.33**	**67**	**0.58**	**1,371**	**0.38**	**5.3**
Z1	**Animal Sciences**	**4.10**	**22**	**0.26**	**1,380**	**2.41**	**16.2**
	114. Ornithology	4.59	21	0.64	293	1.51	11.3
	117. Zoology	3.58	14	0.39	203	4.67	26.1
	108. Entomology	4.02	22	0.10	1,067	3.18	19.0
Z2	**Aquatic Sciences**	**4.71**	**24**	**0.46**	**1,117**	**1.71**	**10.8**
	87. Water Resources	4.16	19	0.39	650	2.52	16.0
	109. Fisheries	4.99	25	0.48	201	1.29	8.2
	112. Marine & Freshwater Biology	4.88	24	0.55	740	2.29	12.1
Z3	**Microbiology**	**4.32**	**67**	**0.52**	**850**	**0.98**	**8.4**
	96. Microbiology	3.74	38	0.01	2,222	3.96	21.3
	97. Parasitology	4.11	24	0.21	332	3.07	17.7
	98. Virology	4.33	66	0.30	367	1.79	11.4

Z4	**Plant Sciences**	**4.35**	**72**	**0.62**	**273**	**0.34**	**5.2**
	110. Forestry	3.65	15	0.51	753	6.81	30.6
	113. Mycology	3.60	16	0.99	394	6.63	34.2
	115. Plant Sciences	4.41	67	0.42	323	0.51	6.6
Z5	**Pure and Applied Ecology**	**4.15**	**36**	**0.42**	**887**	**2.17**	**13.8**
Z6	**Veterinary Sciences**	**3.93**	**22**	**0.29**	**830**	**1.61**	**14.9**
	iii. BIOSCIENCES	3.73	143	0.74	1,869	0.50	7.8
B0	**Multidisciplinary Biology**	**3.74**	**39**	**0.49**	**1,073**	**2.99**	**19.9**
	99. Biology	4.04	43	0.05	460	1.88	15.7
	100. Biology, Miscellaneous	3.59	10	0.65	39	9.22	40.7
	101. Evolutionary Biology	3.43	27	0.46	1,144	10.43	37.0
B1	**Biochemistry, Biophysics & Mol. Biology**	**3.57**	**124**	**0.98**	**1,799**	**0.73**	**9.6**
	88. Biochemical Research Methods	3.14	24	0.17	2,312	6.88	35.7
	89. Biochemistry & Molecular Biology	3.60	125	0.95	1,721	0.81	10.0
	90. Biophysics	4.00	63	0.08	601	1.23	11.1
B2	**Cell Biology**	**3.79**	**148**	**0.04**	**1,063**	**1.27**	**13.4**
B3	**Genetics & Development Biology**	**3.94**	**133**	**0.45**	**573**	**0.74**	**9.5**
	94. Genetics & Heredity	3.84	133	0.40	534	0.85	11.0
	95. Developmental Biology	3.45	68	0.00	860	5.11	29.1
	iv. BIOMEDICAL RESEARCH.	**3.24**	**55**	**0.05**	**4,822**	**1.51**	**16.3**
R1	**Anatomy & Pathology**	**3.87**	**48**	**0.55**	**623**	**1.78**	**15.6**
	123. Pathology	3.85	48	0.61	598	2.06	16.9
	118. Anatomy & Morphology	3.78	21	0.65	246	4.02	22.6
R2	**Biomaterials & Bioengineering**	**3.19**	**32**	**0.00**	**3,314**	**3.95**	**27.6**
	120. Engineering, Biomedical	4.23	36	0.51	296	1.52	11.6
	91. Biotechnology & Applied Microbiology	3.17	39	0.00	1,957	3.02	24.8
R3	**Experimental/Lab. Med.**	**3.53**	**135**	**0.03**	**467**	**0.84**	**15.5**
	121. Medical Laboratory Technology	3.08	16	0.00	932	9.03	42.4
	122. Medicine, Research & Experimental	3.54	135	0.03	465	1.08	17.4
	24. Microscopy	3.65	19	0.02	254	6.36	29.6
R4	**Pharmacology & Toxicology**	**4.24**	**55**	**0.41**	**980**	**0.79**	**8.0**
	128. Pharmacology & Pharmacy	4.24	55	0.23	871	0.86	8.5
	129. Toxicology	3.65	26	0.00	1,157	3.76	21.1
R5	**Physiology**	5.46	53	0.19	450	1.04	6.7
	v. CLINICAL MED. I (INTERNAL)	**3.15**	**79**	**0.04**	**7,072**	**1.54**	**18.3**
I1	**Cardiovascular & Respiratory Medicine**	**3.27**	**49**	**0.00**	**2,768**	**3.80**	**27.6**
	131. Cardiac & Cardiovascular Systems	3.17	49	0.00	2,318	4.19	31.3
	138. Respiratory System	4.11	52	0.23	499	1.76	13.1
I2	**Endocrinology & Metabolism**	**3.54**	**49**	**0.46**	**1,511**	**3.10**	**19.4**

I3	**General & Internal Medicine**	**2.89**	**164**	**0.70**	**755**	**0.53**	**17.0**
	140. Anesthesiology	4.09	32	0.04	434	2.57	17.5
	141. Critical Care Medicine	4.29	58	0.27	243	1.83	14.2
	132. Emergency Medicine	3.60	19	0.58	205	3.00	21.9
	134. Gastroenterology & Hepatology	3.33	42	0.03	1,414	4.01	27.1
	136. Medicine, General & Internal	2.85	172	0.41	653	1.00	29.0
	139. Tropical Medicine	3.80	15	0.08	473	6.90	31.1
I4	**Hematology & Oncology**	**3.58**	**80**	**0.01**	**2,282**	**1.97**	**16.7**
	135. Hematology	3.46	69	0.00	1,517	3.61	24.5
	137. Oncology	3.62	78	0.47	1,298	1.60	14.6
I5	**Immunology**	**3.51**	**81**	**0.07**	**1,522**	**1.51**	**15.3**
	130. Allergy	3.88	44	0.37	195	2.14	16.6
	126. Immunology	3.40	73	0.02	1,833	2.24	19.3
	127. Infectious Diseases	3.78	45	0.03	1,079	3.35	19.8
	vi. CLINICAL MED. II (NON-INT).	**3.77**	**67**	**0.00**	**3,532**	**0.68**	**9.0**
M1	**Age & Gender Related Medicine**	**4.35**	**38**	**0.24**	**857**	**1.56**	**11.6**
	143. Geriatrics & Gerontology	3.92	26	0.11	533	5.64	27.4
	145. Obstetrics & Gynaecology	4.77	52	0.56	173	0.53	5.6
	119. Andrology	3.52	12	0.62	185	12.96	43.9
	92. Reproductive Biology	5.28	56	0.80	133	0.80	6.1
	196. Gerontology	4.36	30	0.52	240	3.45	20.6
M2	**Dentistry**	**3.87**	**17**	**0.04**	**1,105**	**5.24**	**25.4**
M3	**Dermatology & Urogenital System**	**3.73**	**44**	**0.06**	**1,002**	**1.82**	**15.7**
	142. Dermatology	3.65	22	0.00	982	4.57	26.4
	155. Urology & Nephrology	3.72	45	0.18	821	2.44	18.7
M4	**Ophthalmology & Otorhinolaryngology**	**3.78**	**28**	**0.01**	**1,117**	**2.55**	**18.7**
	148. Otorhinolaryngology	4.08	16	0.00	747	4.25	22.5
	146. Ophthalmology	3.82	35	0.01	563	2.15	16.6
M5	**Paramedicine**	**3.90**	**12**	**0.24**	**193**	**7.69**	**31.7**
M6	**Psychiatry & Neurology**	**4.09**	**65**	**0.31**	**1,144**	**1.12**	**11.2**
	157. Clinical Neurology	4.19	67	0.73	640	0.95	10.0
	162. Psychiatry	4.06	65	0.22	478	1.09	10.9
M7	**Radiology & Nuclear Medicine**	**3.80**	**46**	**0.40**	**853**	**1.57**	**14.4**
M8	**Rheumatology & Orthopedics**	**3.82**	**36**	**0.06**	**986**	**1.59**	**14.2**
	147. Orthopedics	4.39	39	0.60	227	0.93	8.9
	151. Rheumatology	3.50	36	0.65	545	5.11	28.3
	152. Sport Sciences	3.72	18	0.00	1,389	6.61	31.0
	179. Rehabilitation	4.25	20	0.01	331	2.34	16.0
M9	**Surgery**	**3.49**	**57**	**0.01**	**2,259**	**1.55**	**16.7**

	153. Surgery	4.17	51	0.07	752	0.72	8.3
	154. Transplantation	3.94	48	0.80	231	1.09	11.5
	150. Peripheral Vascular Disease	**3.36**	**64**	**0.01**	**1,336**	**3.63**	**25.1**
M10	**Pediatrics**	**3.85**	**42**	**0.69**	**417**	**0.97**	**10.9**
	vii. NEUROSCIENCES & BEHAV.	**5.21**	**137**	**0.59**	**291**	**0.14**	**2.6**
N1	**Neurosciences & Psycopharmacology**	**5.25**	**137**	**0.19**	**271**	**0.24**	**3.3**
	158. Neuroimaging	3.69	47	0.14	209	3.32	23.8
	159. Neurosciences	5.21	136	0.18	277	0.25	3.4
N2	**Psychology & Behavioral Sciences**	**4.27**	**57**	**0.39**	**406**	**0.38**	**5.0**
	156. Behavioral Sciences	3.80	23	0.03	917	6.29	24.7
	160. Psychology, Biological	3.27	15	0.16	476	11.86	40.4
	163. Psychology	3.84	27	0.04	677	4.17	21.7
	164. Psychology, Applied	4.62	21	0.73	212	2.40	16.0
	165. Psychology, Clinical	3.95	34	0.43	451	2.50	17.4
	166. Psychology, Developmental	3.72	25	0.01	536	5.31	26.6
	167. Psychology, Educational	3.34	15	0.00	449	8.35	39.9
	168. Psychology, Experimental	4.84	53	0.45	128	0.82	7.8
	169. Psychology, Mathematical	2.81	9	0.03	316	17.95	59.2
	170. Psychology, Multidisciplinary	2.97	16	0.00	1,262	6.65	42.0
	171. Psychology, Psychoanalysis	3.03	8	0.09	219	8.80	48.0
	172. Psychology, Social	3.79	24	0.23	399	4.10	24.2
	161. Social Sciences, Biomedical	3.51	19	0.42	288	4.52	26.7
	viii. CHEMISTRY	**4.25**	**89**	**0.82**	**1,079**	**0.15**	**3.1**
C0	**Multidisciplinary Chemistry**	**4.18**	**87**	**0.68**	**570**	**0.56**	**8.4**
C1	**Analytical, Inorganic & Nuclear Chemistry**	**4.11**	**43**	**0.94**	**1,279**	**1.12**	**9.9**
	55. Chemistry, Inorganic & Nuclear	4.08	29	0.18	1,201	2.45	15.7
	53. Chemistry, Analytical	4.01	42	0.80	966	1.42	12.2
C2	**Applied Chemistry & Chem. Engineering**	**4.24**	**34**	**0.71**	**683**	**0.71**	**8.1**
	54. Chemistry, Applied	3.79	21	0.05	1,284	3.70	21.9
	31. Engineering, Chemical	4.27	33	0.95	457	0.68	8.5
C3	**Organic & Medicinal Chemistry**	**3.97**	**32**	**0.66**	**2,407**	**2.49**	**15.1**
	56. Chemistry, Medicinal	3.83	27	0.58	890	3.63	20.1
	58. Chemistry, Organic	4.02	32	0.77	1,914	2.46	14.6
C4	**Physical Chemistry**	**3.83**	**39**	**0.00**	**2,687**	**1.84**	**14.1**
	59. Chemistry, Physical	3.68	33	0.00	3,673	2.93	19.3
	60. Electrochemistry	4.55	40	0.29	276	1.36	10.1
C5	**Polymer Science**	**3.69**	**35**	**0.23**	**917**	**1.60**	**14.4**
C6	**Materials Science**	**3.61**	**40**	**0.01**	**1,673**	**0.74**	**11.0**
	3. Materials Science, Biomaterials	4.48	40	0.57	148	2.25	13.2

	4. Materials Science, Ceramics	4.49	22	0.35	295	1.47	13.5
	5. Materials Science, Characterization & Testing	3.58	8	0.02	228	3.45	31.2
	6. Materials Science, Coatings & Films	3.61	16	0.00	1,574	7.06	32.2
	7. Materials Science, Composites	3.94	12	0.80	278	2.91	20.9
	8. Materials Science, Multidisciplinary	3.37	33	0.00	2,026	1.47	17.1
	9. Materials Science, Paper & Wood	3.40	6	0.00	588	8.08	43.9
	10. Materials Science, Textiles	3.78	11	0.68	107	2.08	19.5
	11. Metallurgy & Metallurgical Engineering	3.92	33	0.88	249	0.61	9.7
	12. Nanoscience & Nanotechnology	3.04	19	0.00	1,139	5.93	35.4
	ix. PHYSICS	**3.40**	**58**	**0.54**	**4,338**	**0.80**	**12.3**
P0	**Multidisciplinary Ph.**	**3.21**	**56**	**0.10**	**1,857**	**1.63**	**21.7**
	47. Physics, Multidisciplinary	3.33	81	0.32	819	0.98	16.9
	50. Spectroscopy	3.90	31	0.65	511	1.71	14.2
P1	**Applied Physics**	**3.35**	**29**	**0.00**	**4,719**	**2.22**	**20.8**
	39. Acoustics	4.03	18	0.95	387	2.64	17.4
	40. Crystallography	3.07	13	0.04	1,700	6.00	40.5
	41. Optics	3.66	28	0.16	1,240	2.31	19.3
	42. Physics, Applied	3.71	56	0.11	742	0.59	9.0
P2	**Atomic, Molecular & Chemistry Physics**	**3.92**	**43**	**0.94**	**895**	**1.47**	**11.1**
P3	**Classical Physics**	**3.74**	**12**	**0.17**	**796**	**4.50**	**24.3**
P4	**Mathematical & Theoretical Physics**	**3.45**	**22**	**0.72**	**1,397**	**4.13**	**26.2**
P5	**Particle & Nuclear Physics**	**3.44**	**95**	**0.66**	**309**	**0.55**	**11.3**
	48. Physics, Nuclear	3.53	26	0.25	700	2.76	22.8
	49. Physics, Particles & Fields	3.38	94	0.68	299	0.76	14.1
P6	**Physics of Solids, Fluids & Plasmas**	**3.60**	**29**	**0.00**	**3,274**	**2.50**	**19.7**
	44. Physics, Condensed Matter	3.58	30	0.02	2,415	2.26	19.5
	45. Physics, Fluids & Plasmas	3.69	24	0.01	1,095	4.54	23.6
	x. GEOSIENCES & SPACE SCS.	**3.43**	**47**	**0.24**	**3,004**	**1.42**	**15.3**
G1	**Astronomy & Astrophysics**	**3.46**	**72**	**0.30**	**878**	**1.47**	**15.3**
G2	**Geoscs. & Technology**	**3.98**	**27**	**0.01**	**2,245**	**2.48**	**17.4**
	73. Geochemistry & Geophysics	4.35	40	0.57	315	1.21	9.9
	74. Geography, Physical	4.13	26	0.50	244	2.77	16.0
	75. Geology	3.71	17	0.23	566	7.21	32.2
	76. Geosciences, Multidisciplinary	3.95	26	0.05	1,001	2.17	16.2
	25. Imaging Science & Photographic Technology	3.37	24	0.76	176	3.59	28.0
	29. Engineering, Geological	3.55	7	0.31	439	9.44	38.4
	80. Paleontology	3.85	25	0.83	103	1.55	12.4
	81. Remote Sensing	3.19	13	0.85	530	10.54	44.3
G3	**Hydrology/Oceanography**	**4.22**	**24**	**0.75**	**952**	**4.42**	**22.1**

	79. Oceanography	4.24	24	0.47	924	4.81	22.5
	35. Engineering, Ocean	3.25	11	0.42	177	5.10	35.8
G4	**Meteo., Atmos. & Aerosp. Sci. & Tech.**	**3.76**	**35**	**0.89**	**755**	**1.67**	**18.0**
	77. Meteorology & Atmospheric Sciences	3.75	35	0.93	754	2.75	19.2
	32. Engineering, Aerospace	4.71	12	0.52	191	0.94	14.9
G5	**Mineralogy & Petrology**	**3.43**	**15**	**0.01**	**732**	**5.53**	**32.7**
	78. Mineralogy	3.40	14	0.01	648	8.74	37.6
	30. Mining & Mineral Processing	3.49	16	0.62	175	2.38	24.4
	xi. ENGINEERING	**3.50**	**29**	**0.46**	**3,834**	**0.83**	**12.5**
E1	**Computer Science & Information Tech.**	**3.07**	**40**	**0.94**	**656**	**0.55**	**13.1**
	65. Computer Science, Artificial Intelligence	3.33	29	0.53	372	1.57	19.9
	66. Computer Science, Cybernetics	2.99	8	0.02	388	8.27	47.6
	67. Computer Science, Hardware & Architecture	3.01	14	0.42	532	4.01	35.7
	68. Computer Science, Information Systems	3.11	19	0.00	666	3.15	32.6
	69. Computer Science, Interdisciplinary Applicatio	2.80	17	0.20	1,334	4.85	41.9
	70. Computer Science, Software Engineering	3.69	19	0.49	288	1.52	17.8
	71. Computer Science, Theory & Methods	3.19	13	0.48	1,062	3.19	30.9
	72. Mathematical & Computational Biology	2.60	14	0.56	1,011	13.65	59.7
E2	**Electrical & Electronic Engineering**	**3.39**	**23**	**0.02**	**2,182**	**1.69**	**19.3**
	1. Engineering, Electrical & Electronic	3.39	23	0.01	2,150	1.72	19.4
	2. Telecommunications	3.25	21	0.81	360	1.54	22.7
E3	**Energy & Fuels**	**3.72**	**18**	**0.13**	**1,316**	**1.91**	**18.4**
	26. Energy & Fuels	3.66	20	0.46	477	1.58	17.8
	27. Nuclear Science & Technology	3.77	17	0.31	799	2.17	18.1
	28. Engineering, Petroleum	4.06	9	0.12	160	1.39	26.6
E4	**General & Traditional Engineering**	**3.73**	**20**	**0.00**	**3,989**	**1.85**	**17.6**
	13. Construction & Building Technology	4.22	10	0.02	307	3.48	21.4
	14. Engineering, Civil	4.16	17	0.90	256	1.11	12.4
	15. Engineering, Environmental	3.82	31	0.09	537	2.55	19.7
	16. Engineering, Marine	2.80	3	0.34	52	1.86	58.7
	17. Transportation Science & Technology	3.60	8	0.24	268	4.45	35.8
	18. Engineering, Industrial	3.79	8	0.03	764	5.40	31.2
	19. Engineering, Manufacturing	4.43	12	0.48	271	1.87	13.8
	20. Engineering, Mechanical	4.02	18	0.60	481	1.17	12.0
	21. Mechanics	4.21	22	0.17	668	1.54	13.1
	22. Robotics	3.35	8	0.04	227	7.08	38.5
	23. Instruments & Instrumentation	3.96	20	0.57	844	2.09	17.9
	33. Automation & Control Systems	3.15	10	0.03	1,005	5.80	37.7
	34. Engineering, Multidisciplinary	3.70	17	0.78	410	1.80	19.7

	36. Ergonomics	3.40	8	0.01	331	10.88	40.9
	38. Operations Research & Management Science	3.60	10	0.00	1,026	5.51	30.5
	xii. MATHEMATICS	**3.24**	**18**	**0.18**	**2,423**	**1.74**	**20.7**
H1	**Applied Mathematics**	3.14	18	0.13	2,128	2.38	24.8
	63. Mathematics, Applied	3.55	13	0.00	1,654	3.12	23.9
	64. Statistics & Probability	2.64	13	0.09	1,588	6.84	49.0
	37. Mathematics, Interdisciplinary Applications	4.33	32	0.20	160	0.91	10.0
H2	**Pure Mathematics**	**3.84**	**12**	**0.00**	**1,250**	**1.89**	**17.1**

Table E3. Power Law Estimation Results. Thomson Scientific Fields

		α	ρ	*p*-value	No. of Power Law Articles	% of Total Articles	% of Citations
		(1)	(2)	(3)	(4)	(5)	(6)
LIFE SCIENCES							
I	**Clinical Medicine**	3.16	53	0.20	15,250	1.61	19.1
II	**Biology & Biochemistry**	3.56	123	0.90	1,965	0.49	8.1
III	**Neuroscience & Behavioral Science**	5.04	136	0.33	318	0.18	2.9
IV	**Molecular Biology & Genetics**	3.85	153	0.05	1,237	0.82	10.5
V	**Psychiatry & Psychology**	4.13	65	0.53	651	0.53	7.2
VI	**Pharmacology & Toxicology**	4.24	55	0.46	980	0.79	8.0
VII	**Microbiology**	4.32	67	0.48	850	0.98	8.4
VIII	**Immunology**	3.51	81	0.09	1,522	1.56	15.4
PHYSICAL SCIENCES							
IX	**Chemistry**	4.28	87	0.61	969	0.21	3.8
X	**Physics**	3.40	58	0.52	4,338	0.80	12.3
XI	**Computer Science**	3.08	27	0.21	1,457	1.54	22.0
XII	**Mathematics**	3.14	13	0.40	3,973	3.20	29.3
XIII	**Space Science**	3.46	72	0.30	878	1.47	15.3
OTHER NATURAL SCIENCES							
XIV	**Engineering**	3.60	22	0.05	5,092	1.36	15.7
XV	**Plant & Animal Science**	4.17	56	0.75	718	0.32	5.1
XVI	**Material Science**	3.61	40	0.03	1,672	0.76	11.1
XVII	**Geosciences**	3.99	33	0.23	2,352	1.83	14.0
XVIII	**Environment & Ecology**	4.12	36	0.23	1,896	1.43	11.6
XIX	**Agricultural Sciences**	3.83	32	0.00	1,470	1.50	13.8
XX	**Multidisciplinary**	3.25	34	0.18	421	1.32	22.4
SOCIAL SCIENCES							
XXI	**Social Sciences, General**	4.15	28	0.43	978	0.63	8.9
XXII	**Economics & Business**	4.61	46	0.51	209	0.33	6.3

Table F. Power Law Estimation Results for the Third Aggregation Scheme: Thomson Scientific Sub-fields, New Disciplines and New Fields

		α	ρ	*p*-value	No. of Power Law Articles	% of Total Articles	% of Citations
		(1)	(2)	(3)	(4)	(5)	(6)
	i. BIOSCIENCES	***3.73***	***143***	***0.77***	***370,134***	***0.50***	***7.8***
D1	**Multidisciplinary Biology**	**3.74**	**39**	**0.47**	**35,878**	**2.99**	**19.9**
	99. Biology	4.04	43	0.05	460	1.88	15.7
	100. Biology, Miscellaneous	3.59	10	0.65	39	9.22	40.7
	101. Evolutionary Biology	3.43	27	0.46	1,144	10.43	37.0
D2	**Biochemistry/Biophysics/Mol. Biol**	**3.57**	**124**	**0.97**	**248,022**	**0.73**	**9.6**
	88. Biochemical Research Methods	3.14	24	0.17	2,312	6.88	35.7
	89. Biochemistry & Molecular Biology	3.60	125	0.95	1,721	0.81	10.0
	90. Biophysics	4.00	63	0.08	601	1.23	11.1
D3	**Cell Biology** (93)	**3.79**	**148**	**0.04**	**83,777**	**1.27**	**13.4**
D4	**Genetics & Development Biology**	**3.94**	**133**	**0.49**	**77,680**	**0.74**	**9.5**
	94. Genetics & Heredity	3.84	133	0.40	534	0.85	11.0
	95. Development Biology	3.45	68	0.00	860	5.11	29.1
	ii. BIOMEDICAL RESEARCH	***3.84***	***49***	***0.24***	***288,558***	***1.33***	***12.1***
D5	**Anatomy & Pathology**	**3.87**	**48**	**0.54**	**34,962**	**1.78**	**15.6**
	123. Pathology	3.85	48	0.61	598	2.06	16.9
	118. Anatomy & Morphology	3.78	21	0.65	246	4.02	22.6
D6	**Biomaterials & Bioengineering**	**3.19**	**32**	**0.00**	**83,994**	**3.95**	**27.6**
	120. Engineering, Biomedical	4.23	36	0.51	296	1.52	11.6
	91. Biotechnology & Applied Microbiology	3.17	39	0.00	1,957	3.02	24.8
D7*	**Experimental & Laboratory Med.**	**3.26**	**18**	**0.00**	**14,309**	**7.23**	**35.9**
	121. Medical Laboratory Technology	3.08	16	0.00	932	9.03	42.4
	24. Microscopy	3.65	19	0.02	254	6.36	29.6
D8	**Pharmacology & Toxicology**	**4.24**	**55**	**0.45**	**124,416**	**0.79**	**8.0**
	128. Pharmacology & Pharmacy	4.24	55	0.23	871	0.86	8.5
	129. Toxicology	3.65	26	0.00	1,157	3.76	21.1
D9	**Physiology** (124)	**5.46**	**53**	**0.21**	**43,378**	**1.04**	**6.7**
	iii. CL. MED. I (INTERNAL)	***3.15***	***79***	***0.04***	***459,991***	***1.54***	***18.3***
D10	**Cardiovascular & Respiratory Medic**	**3.27**	**49**	**0.00**	**72,773**	**3.80**	**27.6**

	131. Cardiac & Cardiovascular Systems	3.17	49	0.00	2,318	4.19	31.3
	138. Respiratory System	4.11	52	0.23	499	1.76	13.1
D11	**Endocrinology & Metabolism (**133**)**	**3.54**	**49**	**0.44**	**48,723**	**3.10**	**19.4**
D12	**General & Internal Medicine**	**2.89**	**164**	**0.71**	**141,296**	**0.53**	**17.0**
	140. Anesthesiology	4.09	32	0.04	434	2.57	17.5
	141. Critical Care Medicine	4.29	58	0.27	243	1.83	14.2
	132. Emergency Medicine	3.60	19	0.58	205	3.00	21.9
	134. Gastroenterology & Hepatology	3.33	42	0.03	1,414	4.01	27.1
	136. Medicine, General & Internal	2.85	172	0.41	653	1.00	29.0
	139. Tropical Medicine	3.80	15	0.08	473	6.90	31.1
D13	**Hematology & Oncology**	**3.58**	**80**	**0.01**	**115,938**	**1.97**	**16.7**
	135. Hematology	3.46	69	0.00	1,517	3.61	24.5
	137. Oncology	3.62	78	0.47	1,298	1.60	14.6
D14	**Immunology**	**3.51**	**81**	**0.09**	**100,492**	**1.51**	**15.3**
	130. Allergy	3.88	44	0.37	195	2.14	16.6
	126. Immunology	3.40	73	0.02	1,833	2.24	19.3
	127. Infectious Diseases	3.78	45	0.03	1,079	3.35	19.8
	iv. CL. MED. II (NON-INT.)	***3.76***	***66***	***0.01***	***509,905***	***0.72***	***9.3***
D15	**Age & Gender Related Medicine**	**4.35**	**38**	**0.29**	**55,016**	**1.56**	**11.6**
	143. Geriatrics & Gerontology	3.92	26	0.11	533	5.64	27.4
	145. Obstetrics & Gynaecology	4.77	52	0.56	173	0.53	5.6
	119. Andrology	3.52	12	0.62	185	12.96	43.9
	92. Reproductive Biology	5.28	56	0.80	133	0.80	6.1
	196. Gerontology	4.36	30	0.52	240	3.45	20.6
D16	**Dentistry (**173**)**	**3.87**	**17**	**0.04**	**21,077**	**5.24**	**25.4**
D17	**Dermatology & Urogenital System**	**3.73**	**44**	**0.07**	**55,202**	**1.82**	**15.7**
	142. Dermatology	3.65	22	0.00	982	4.57	26.4
	155. Urology & Nephrology	3.72	45	0.18	821	2.44	18.7
D18	**Ophthalmology & Otorhinolaryngol**	**3.78**	**28**	**0.02**	**43,788**	**2.55**	**18.7**
	148. Otorhinolaryngology	4.08	16	0.00	747	4.25	22.5
	146. Ophthalmology	3.82	35	0.01	563	2.15	16.6
D19	**Paramedicine (**144**)**	**3.90**	**12**	**0.25**	**2,511**	**7.69**	**31.7**
D20	**Psychiatry & Neurology**	**4.09**	**65**	**0.28**	**101,744**	**1.12**	**11.2**
	157. Clinical Neurology	4.19	67	0.73	640	0.95	10.0
	162. Psychiatry	4.06	65	0.22	478	1.09	10.9
D21	**Radiology & Nuclear Med. (**125**)**	**3.80**	**46**	**0.38**	**54,431**	**1.57**	**14.4**
D22*	**Rheumatology & Orthopedics**	**3.79**	**35**	**0.06**	**51,850**	**2.00**	**16.2**
	147. Orthopedics	4.39	39	0.60	227	0.93	8.9

	151. Rheumatology	3.50	36	0.65	545	5.11	28.3
	152. Sport Sciences	3.72	18	0.00	1,389	6.61	31.0
D23	**Surgery**	**3.49**	**57**	**0.02**	**146,033**	**1.55**	**16.7**
	153. Surgery	4.17	51	0.07	752	0.72	8.3
	154. Transplantation	3.94	48	0.80	231	1.09	11.5
	150. Peripheral Vascular Disease	3.36	64	0.01	1,336	3.63	25.1
D24	**Pediatrics (**149**)**	**3.85**	**42**	**0.69**	**42,958**	**0.97**	**10.9**
	v. CLINICAL MED. III	***4.48***	***55***	***0.16***	***107,452***	***0.37***	***5.1***
D25*	**Health Sciences**	**4.48**	**55**	**0.28**	**98,541**	**0.40**	**5.2**
	174. Health Care Sciences & Services	3.63	27	0.44	356	2.42	18.1
	175. Health Policy & Services	3.15	16	0.18	821	8.34	39.9
	176. Medicine, Legal	3.31	12	0.26	329	7.51	35.3
	177. Nursing	3.67	9	0.10	636	6.98	31.8
	178. Public, Environmental & Occup. Health	4.00	38	0.01	904	1.79	14.3
	179. Rehabilitation	4.25	20	0.01	331	2.34	16.0
	180. Substance Abuse	3.61	17	0.00	830	10.58	37.2
D26*	**Other Clinical Medicine**	**3.39**	**15**	**0.54**	**14,644**	**3.77**	**27.5**
	181. Education, Scientific Disciplines	4.21	18	0.59	142	1.73	15.6
	182. Medical Informatics	3.11	13	0.96	439	6.82	38.5
	vi. NEURO. SC. & BEHAV.	***5.21***	***137***	***0.59***	***209,740***	***0.14***	***2.6***
D27	**Neurosciences & Psycopharmacolo[g]**	**5.21**	**136**	**0.14**	**114,271**	**0.24**	**3.4**
	158. Neuroimaging	3.69	47	0.14	209	3.32	23.8
	159. Neurosciences	5.21	136	0.18	277	0.25	3.4
D28	**Psychology & Behavioral Sciences**	**4.27**	**57**	**0.43**	**105,694**	**0.38**	**5.0**
	156. Behavioral Sciences	3.80	23	0.03	917	6.29	24.7
	160. Psychology, Biological	3.27	15	0.16	476	11.86	40.4
	163. Psychology	3.84	27	0.04	677	4.17	21.7
	164. Psychology, Applied	4.62	21	0.73	212	2.40	16.0
	165. Psychology, Clinical	3.95	34	0.43	451	2.50	17.4
	166. Psychology, Developmental	3.72	25	0.01	536	5.31	26.6
	167. Psychology, Educational	3.34	15	0.00	449	8.35	39.9
	168. Psychology, Experimental	4.84	53	0.45	128	0.82	7.8
	169. Psychology, Mathematical	2.81	9	0.03	316	17.95	59.2
	170. Psychology, Multidisciplinary	2.97	16	0.00	1,262	6.65	42.0
	171. Psychology, Psychoanalysis	3.03	8	0.09	219	8.80	48.0
	172. Psychology, Social	3.79	24	0.23	399	4.10	24.2
	161. Social Sciences, Biomedical	3.51	19	0.42	288	4.52	26.7

	vii. CHEMISTRY	***4.30***	***88***	***0.72***	***534,994***	***0.20***	***3.5***
D29	**Multidisciplinary Chemistry (**57**)**	**4.18**	**87**	**0.68**	**101,864**	**0.56**	**8.4**
D30	**Analytical, Inorganic & Nuclear Ch.**	**4.11**	**43**	**0.94**	**114,057**	**1.12**	**9.9**
	55. Chemistry, Inorganic & Nuclear	4.08	29	0.18	1,201	2.45	15.7
	53. Chemistry, Analytical	4.01	42	0.80	966	1.42	12.2
D31	**Applied Chem. & Chem. Eng.**	**4.24**	**34**	**0.69**	**95,945**	**0.71**	**8.1**
	54. Chemistry, Applied	3.79	21	0.05	1,284	3.70	21.9
	31. Engineering, Chemical	4.27	33	0.95	457	0.68	8.5
D32	**Organic & Medicinal Chemistry**	**3.97**	**32**	**0.65**	**96,627**	**2.49**	**15.1**
	56. Chemistry, Medicinal	3.83	27	0.58	890	3.63	20.1
	58. Chemistry, Organic	4.02	32	0.77	1,914	2.46	14.6
D33	**Physical Chemistry**	**3.83**	**39**	**0.00**	**145,810**	**1.84**	**14.1**
	59. Chemistry, Physical	3.68	33	0.00	3,673	2.93	19.3
	60. Electrochemistry	4.55	40	0.29	276	1.36	10.1
D34	**Polymer Science (**61**)**	**3.69**	**35**	**0.24**	**57,159**	**1.60**	**14.4**
	viii. PHYSICS	***3.40***	***55***	***0.18***	***512,151***	***0.94***	***13.1***
D35	**Multidisciplinary Physics**	**3.21**	**56**	**0.10**	**113,631**	**1.63**	**21.7**
	47. Physics, Multidisciplinary	3.33	81	0.32	819	0.98	16.9
	50. Spectroscopy	3.90	31	0.65	511	1.71	14.2
D36*	**Applied Physics**	**3.71**	**62**	**0.68**	**184,147**	**0.37**	**6.5**
	39. Acoustics	4.03	18	0.95	387	2.64	17.4
	41. Optics	3.66	28	0.16	1,240	2.31	19.3
	42. Physics, Applied	3.71	56	0.11	742	0.59	9.0
D37	**Atomic, Mol. & Chem. Physics (**43**)**	**3.92**	**43**	**0.91**	**60,889**	**1.47**	**11.1**
D38	**Classical Physics (**51**)**	**3.74**	**12**	**0.16**	**17,689**	**4.50**	**24.3**
D39	**Math. & Theoretical Physics (**46**)**	**3.45**	**22**	**0.75**	**33,785**	**4.13**	**26.2**
D40	**Particle & Nuclear Physics**	**3.44**	**95**	**0.68**	**56,668**	**0.55**	**11.3**
	48. Physics, Nuclear	3.53	26	0.25	700	2.76	22.8
	49. Physics, Particles & Fields	3.38	94	0.68	299	0.76	14.1
D41	**Physics of Solids, Fluids & Plasmas**	**3.60**	**29**	**0.00**	**131,006**	**2.50**	**19.7**
	44. Physics, Condensed Matter	3.58	30	0.02	2,415	2.26	19.5
	45. Physics, Fluids & Plasmas	3.69	24	0.01	1,095	4.54	23.6
	ix. SPACE SCIENCES	***3.46***	***72***	***0.33***	***59,843***	***1.47***	***15.3***
D42	**Astronomy & Astrophysics (**52**)**	**3.46**	**72**	**0.32**	**59,843**	**1.47**	**15.3**
	x. MATHEMATICS	***3.24***	***18***	***0.15***	***141,318***	***1.75***	***20.7***

D43*	**Applied Mathematics**	**3.15**	**18**	**0.25**	**91,320**	**2.38**	**24.7**
	63. Mathematics, Applied	3.55	13	0.00	1,654	3.12	23.9
	64. Statistics & Probability	2.64	13	0.09	1,588	6.84	49.0
	37. Mathematics, Interdisciplinary Applications	4.33	32	0.20	160	0.91	10.0
	216. Social Sciences, Mathematical Methods	3.07	13	0.00	370	6.82	38.7
D44	**Pure Mathematics (**62**)**	**3.84**	**12**	**0.00**	**66,308**	**1.89**	**17.1**
	xi. COMPUTER SC. & ENG.	***3.47***	***27***	***0.46***	***468,343***	***0.99***	***14.0***
D45	**Computer Sc. & Information Tech.**	**3.07**	**40**	**0.95**	**120,147**	**0.55**	**13.1**
	65. Computer Science, Artificial Intelligence	3.33	29	0.53	372	1.57	19.9
	66. Computer Science, Cybernetics	2.99	8	0.02	388	8.27	47.6
	67. Computer Science, Hardware & Architectur	3.01	14	0.42	532	4.01	35.7
	68. Computer Science, Information Systems	3.11	19	0.00	666	3.15	32.6
	69. Computer Science, Interdisciplinary Applica	2.80	17	0.20	1,334	4.85	41.9
	70. Computer Science, Software Engineering	3.69	19	0.49	288	1.52	17.8
	71. Computer Science, Theory & Methods	3.19	13	0.48	1,062	3.19	30.9
	72. Mathematical & Computational Biology	2.60	14	0.56	1,011	13.65	59.7
D46	**Electrical & Electronic Engineering**	**3.39**	**23**	**0.02**	**129,184**	**1.69**	**19.3**
	1. Engineering, Electrical & Electronic	3.39	23	0.01	2,150	1.72	19.4
	2. Telecommunications	3.25	21	0.81	360	1.54	22.7
D47*	**Civil Engineering**	**3.86**	**31**	**0.11**	**49,560**	**1.15**	**14.4**
	13. Construction & Building Technology	4.22	10	0.02	307	3.48	21.4
	14. Engineering, Civil	4.16	17	0.90	256	1.11	12.4
	15. Engineering, Environmental	3.82	31	0.09	537	2.55	19.7
	16. Engineering, Marine	2.80	3	0.34	52	1.86	58.7
	17. Transportation Science & Technology	3.60	8	0.24	268	4.45	35.8
D48*	**Mechanical Engineering**	**4.18**	**22**	**0.36**	**97,075**	**0.91**	**10.0**
	18. Engineering, Industrial	3.79	8	0.03	764	5.40	31.2
	19. Engineering, Manufacturing	4.43	12	0.48	271	1.87	13.8
	20. Engineering, Mechanical	4.02	18	0.60	481	1.17	12.0
	21. Mechanics	4.21	22	0.17	668	1.54	13.1
	22. Robotics	3.35	8	0.04	227	7.08	38.5
D49*	**Instruments & Instrumentation**	**3.79**	**21**	**0.53**	**45,031**	**2.15**	**18.9**
	23. Instruments & Instrumentation	3.96	20	0.57	844	2.09	17.9
	25. Imaging Sc. & Photographic Technology	3.37	24	0.76	176	3.59	28.0
D50	**Fuel & Energy**	**3.72**	**18**	**0.14**	**68,928**	**1.91**	**18.4**
	26. Energy & Fuels	3.66	20	0.46	477	1.58	17.8
	27. Nuclear Science & Technology	3.77	17	0.31	799	2.17	18.1
	28. Engineering, Petroleum	4.06	9	0.12	160	1.39	26.6

D51* Other Engineering	**3.82**	**19**	**0.54**	**58,257**	**1.33**	**14.3**
33. Automation & Control Systems	3.15	10	0.03	1,005	5.80	37.7
34. Engineering, Multidisciplinary	3.70	17	0.78	410	1.80	19.7
36. Ergonomics	3.40	8	0.01	331	10.88	40.9
38. Operations Research & Management Scienc	3.60	10	0.00	1,026	5.51	30.5
xii. MATERIALS SCIENCE	***3.91***	***43***	***0.59***	***129,880***	***0.45***	***7.2***
D52* Materials Science	**3.91**	**43**	**0.61**	**129,880**	**0.45**	**7.2**
3. Materials Science, Biomaterials	4.48	40	0.57	148	2.25	13.2
4. Materials Science, Ceramics	4.49	22	0.35	295	1.47	13.5
5. Materials Science, Characterization & Testing	3.58	8	0.02	228	3.45	31.2
6. Materials Science, Coatings & Films	3.61	16	0.00	1,574	7.06	32.2
7. Materials Science, Composites	3.94	12	0.80	278	2.91	20.9
9. Materials Science, Paper & Wood	3.40	6	0.00	588	8.08	43.9
10. Materials Science, Textiles	3.78	11	0.68	107	2.08	19.5
11. Metallurgy & Metallurgical Engineering	3.92	33	0.88	249	0.61	9.7
12. Nanoscience & Nanotechnology	3.04	19	0.00	1,139	5.93	35.4
xiii. GEOSCIENCES	***4.06***	***41***	***0.76***	***125,005***	***0.88***	***9.4***
D53* Geosciences & Technology	**4.30**	**40**	**0.68**	**53,060**	**0.92**	**8.6**
73. Geochemistry & Geophysics	4.35	40	0.57	315	1.21	9.9
74. Geography, Physical	4.13	26	0.50	244	2.77	16.0
75. Geology	3.71	17	0.23	566	7.21	32.2
29. Engineering, Geological	3.55	7	0.31	439	9.44	38.4
80. Paleontology	3.85	25	0.83	103	1.55	12.4
81. Remote Sensing	3.19	13	0.85	530	10.54	44.3
D54 Hydrology & Oceanography	**4.22**	**24**	**0.77**	**21,537**	**4.42**	**22.1**
79. Oceanography	4.24	24	0.47	924	4.81	22.5
35. Engineering, Ocean	3.25	11	0.42	177	5.10	35.8
D55 Meteo., Atmos., Aero. Sci. & Tech.	**3.76**	**35**	**0.91**	**45,125**	**1.67**	**18.0**
77. Meteorology & Atmospheric Sciences	3.75	35	0.93	754	2.75	19.2
32. Engineering, Aerospace	4.71	12	0.52	191	0.94	14.9
D56 Mineralogy & Petrology	**3.43**	**15**	**0.01**	**13,246**	**5.53**	**32.7**
78. Mineralogy	3.40	14	0.01	648	8.74	37.6
30. Mining & Mineral Processing	3.49	16	0.62	175	2.38	24.4
xiv. AGRIC. AND ENVIRON.	***4.58***	***62***	***0.73***	***216,170***	***0.21***	***3.5***
D57 Agricultural Science & Technology	**4.26**	**29**	**0.20**	**42,585**	**1.12**	**10.9**
102. Agricultural Engineering	3.68	9	0.24	387	8.82	35.6

	103. Agriculture, Multidisciplinary	3.52	19	0.01	636	4.31	27.5
	104. Agronomy	4.48	26	0.60	331	1.40	12.2
D58	**Plant & Animal Science & Tech.**	**4.87**	**30**	**0.87**	**19,750**	**1.22**	**9.1**
	85. Limnology	4.67	29	0.52	155	2.81	15.8
	86. Soil Science	4.61	22	0.09	299	2.10	13.2
D59	**Environmental Science & Tech.**	**4.01**	**36**	**0.34**	**82,436**	**1.28**	**11.5**
	82. Biodiversity Conservation	3.44	18	0.23	511	7.83	37.6
	84. Environmental Sciences	4.02	37	0.54	960	1.36	11.7
	191. Environmental Studies	3.64	11	0.10	610	6.13	29.5
D60	**Food & Animal Science & Tech.**	**3.81**	**32**	**0.00**	**92,178**	**1.56**	**14.1**
	105. Food Science & Technology	3.92	21	0.05	1,309	2.93	18.4
	106. Nutrition & Dietetics	3.72	37	0.00	656	2.98	20.6
	107. Agriculture, Dairy & Animal Science	4.12	18	0.10	621	2.86	19.7
	111. Horticulture	4.43	25	0.01	201	1.99	15.4
	xv. PLANT &ANIMAL SC.	***4.33***	***67***	***0.57***	***357,768***	***0.38***	***5.3***
D61	**Animal Sciences**	**4.10**	**22**	**0.27**	**57,250**	**2.41**	**16.2**
	114. Ornithology	4.59	21	0.64	293	1.51	11.3
	117. Zoology	3.58	14	0.39	203	4.67	26.1
	108. Entomology	4.02	22	0.10	1,067	3.18	19.0
D62	**Aquatic Sciences**	**4.71**	**24**	**0.44**	**65,235**	**1.71**	**10.8**
	87. Water Resources	4.16	19	0.39	650	2.52	16.0
	109. Fisheries	4.99	25	0.48	201	1.29	8.2
	112. Marine & Freshwater Biology	4.88	24	0.55	740	2.29	12.1
D63	**Microbiology**	**4.32**	**67**	**0.52**	**86,780**	**0.98**	**8.4**
	96. Microbiology	3.74	38	0.01	2,222	3.96	21.3
	97. Parasitology	4.11	24	0.21	332	3.07	17.7
	98. Virology	4.33	66	0.30	367	1.79	11.4
D64	**Plant Sciences**	**4.35**	**72**	**0.63**	**79,538**	**0.34**	**5.2**
	110. Forestry	3.65	15	0.51	753	6.81	30.6
	113. Mycology	3.60	16	0.99	394	6.63	34.2
	115. Plant Sciences	4.41	67	0.42	323	0.51	6.6
D65	**Pure and Applied Ecology (**83**)**	**4.15**	**36**	**0.37**	**40,881**	**2.17**	**13.8**
D66	**Veterinary Sciences (**116**)**	**3.93**	**22**	**0.29**	**51,650**	**1.61**	**14.9**
	xvi. MULTIDISCIPLINARY	***3.25***	***34***	***0.17***	***31,984***	***1.32***	***22.4***
D67*	**Multidisciplinary (**183**)**	**3.25**	**34**	**0.15**	**31,984**	**1.32**	**22,.4**
	xvii. RESIDUAL SUB-FIELDS	***2.58***	***16***	***0.00***	***254,820***	***8.45***	***50.5***

D68* Materials Science, Multidiscipl. (8)	**3.37**	**33**	**0.00**	**137,363**	**1.47**	**17.1**
D69* Crystallography (40)	**3.07**	**13**	**0.06**	**28,320**	**6.00**	**40.5**
D70* Geosciences, Multidisciplinary (76)	**3.95**	**26**	**0.05**	**46,211**	**2.17**	**16.2**
D71* Medicine, Research & Exp. (122)	**3.54**	**135**	**0.03**	**43,246**	**1.08**	**17.4**
xviii. SOCIAL SCS., GENERAL	***4.09***	***24***	***0.98***	***143,364***	***0.76***	***10.1***
D72* Law & Criminology	**3.91**	**18**	**0.25**	**16,229**	**2.17**	**20.2**
187. Criminology & Penology	4.50	17	0.16	103	2.82	21.6
200. Law	4.32	24	0.43	136	1.03	12.6
D73* Political Science & Public Adm.	**4.04**	**22**	**0.39**	**20,339**	**0.66**	**11.2**
204. Political Science	3.97	22	0.70	122	0.72	12.9
205. Public Administration	3.83	10	0.52	176	4.66	28.5
D74* Sociology & Other Social Studies	**3.89**	**19**	**0.46**	**30,039**	**1.51**	**15.4**
193. Ethnic Studies	3.00	6	0.68	71	7.95	49.3
194. Family Studies	4.26	19	0.55	142	2.72	18.0
206. Social Issues	3.29	10	0.32	230	4.42	33.8
208. Social Work	5.50	17	0.64	63	1.28	10.0
209. Sociology	3.82	19	0.45	238	1.83	18.6
212. Women's Studies	3.39	10	0.47	211	5.35	32.2
D75* Education	**4.08**	**16**	**0.36**	**19,645**	**1.51**	**14.8**
189. Education & Educational Research	3.42	9	0.04	799	4.81	31.6
190. Education, Special	4.07	14	0.33	134	4.41	24.4
D76* Geography, Planning & Urban	**3.80**	**16**	**0.73**	**21,226**	**2.21**	**18.4**
185. Area Studies	4.95	10	0.52	45	1.06	11.2
195. Geography	3.20	10	0.05	610	10.94	44.5
203. Planning & Development	3.58	13	0.66	255	3.70	26.8
210. Transportation	4.35	12	0.15	103	5.35	25.2
211. Urban Studies	3.23	8	0.00	471	9.99	42.7
D77* Ethics	**3.90**	**10**	**0.82**	**5,051**	**3.58**	**24.4**
192. Ethics	3.99	10	0.45	164	3.44	23.4
202. Medical Ethics	3.69	10	0.58	103	9.36	39.2
D78* Other Social Sciences	**4.18**	**27**	**0.89**	**49,447**	**0.62**	**9.1**
184. Anthropology	3.38	9	0.00	632	8.23	42.3
186. Communication	3.01	6	0.00	785	15.33	54.8
188. Demography	2.51	5	0.00	632	27.29	74.9
197. History Of Social Sciences	4.60	6	0.71	62	3.70	21.8
198. Information Science & Library Science	3.05	12	0.34	462	4.27	38.1
199. International Relations	2.85	8	0.02	506	6.36	47.4
201. Linguistics	3.40	12	0.04	500	7.81	39.2

207. Social Sciences, Interdisciplinary	3.91	14	0.08	212	2.30	20.0
xix. ECON. & BUSINESS	***4.69***	***46***	***0.67***	***69,913***	***0.31***	***6.0***
D79* Economics	**2.84**	**9**	**0.00**	**38,884**	**9.55**	**48.5**
213. Agricultural Economics & Policy	3.94	8	0.48	134	7.57	33.2
214. Economics	2.83	9	0.00	3616	9.74	49.1
215. Industrial Relations & Labor	3.52	8	0.51	251	11.09	45.8
D80* Business & Management	**5.20**	**46**	**0.93**	**36,081**	**0.33**	**6.3**
217. Business	4.69	36	0.18	108	0.83	11.2
218. Business, Finance	2.66	10	0.00	876	6.93	58.9
219. Management	3.65	23	0.00	408	2.89	23.1